



ShipLAB Research Portfolio 2015

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Nautical Archaeology Program
Center for Maritime Archaeology and Conservation



ShipLAB (Photo: Rodrigo Torres, 2014)

Acknowledgements

The ShipLAB work would not be possible without the sponsorship of many persons and institutions. This portfolio belongs to them.

Texas A&M Alumni **Dr. Peter and Nancy Amaral** have supported the research of countless students for over a decade now, making most of their research possible and setting the base for their professional futures.

Mr. Charles Consolvo has also supported our projects through the Institute of Nautical Archaeology, making the Playa Damas and Puerto Rico possible, among many other projects.

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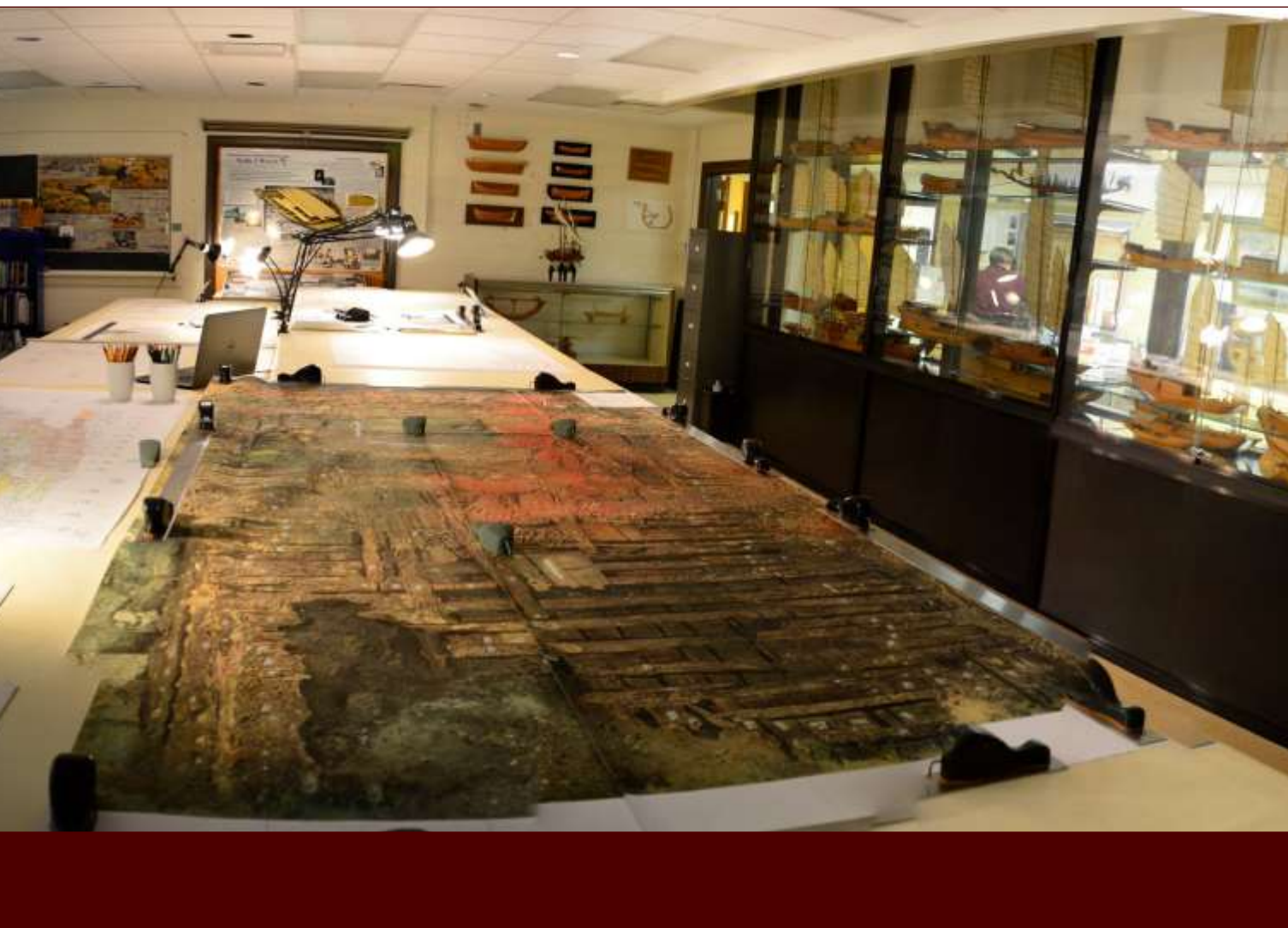
The **Croatian Ministry of Culture**, for their support of the Gnalčić project.

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The **Portuguese Ministry of Culture**, who supported the Pepper Wreck project.

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The **Luso-American Foundation**, for their support of the Lagos project and many other initiatives.

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J.-B. Pelletier, Senior Nautical Archaeologist and Remote Sensing Specialist at **URS Corporation**, who has been teaching our students remote sensing for years now.



The **Centre for Maritime Archaeology and Conservation** at Texas A&M University.

Pat Sanders, founder and president of **Hypack Inc.**, Lourdes Evans, and Christian Shaw, for sponsoring our remote sensing courses.



HYPACK, Inc.
Seaworthy Software

Texas A&M University.



J. Richard Steffy Ship Reconstruction Laboratory

Director: FILIPE VIEIRA DE CASTRO | PROFESSOR

Frederic R. Mayer Fellow II of Nautical Archaeology

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ShipLAB Mission

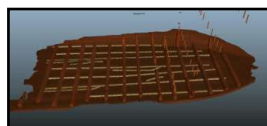
The ShipLab was created by J. Richard Steffy in 1976 and today is one of the laboratories of the Centre for Maritime Archaeology and Conservation of the Anthropology Department at Texas A&M University. Our mission is to acquire and disseminate knowledge about shipbuilding through time. As a **classroom** our main objective is to provide an effective learning environment. As a **research laboratory** our objective is to facilitate investigation, seek public and private research funds, and recruit and retain quality students for our projects. As an **outreach institution** we aim at providing information, education, and guidance on the discipline of nautical archaeology and the importance of the world's submerged cultural heritage, perhaps more than ever threatened by treasure hunting.

Main Research Interests



Computers and the dissemination of knowledge - Archaeologists publish a small percentage (around 25%) of the sites they dig and thus destroy forever. At the ShipLAB we believe that the development of computer science, computer graphics, and the internet, have created an environment which can help promote a paradigm change, allowing archaeologists to survey and record faster and cheaper, and to share their primary data in real time.

pp. 22-23



Ship Modeling and Computer Graphics - A cooperation between the Department of Visualization, Texas A&M University, and Centre for Marine Technology and Engineering, Instituto Superior Técnico, Lisbon, Portugal.

pp. 24-27



Submerged Cultural Heritage - A substantial portion of the world's submerged cultural heritage was destroyed in the last 50 years by treasure hunters. This problem has been a major interest and research subject in the ShipLAB.

pp. 28-33



Iberian Seafaring - The maritime expansion of the late 15th and early 16th centuries had a major impact on European history, although the ships that made it possible are largely unknown to us. The ShipLAB has devoted a considerable time and effort to the study of the people that conceived, built and sailed the ships that first mapped the world, in the end of the Middle Age.

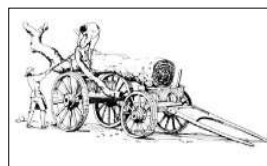
pp. 34-37

Projects



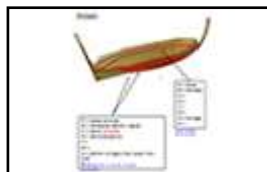
GroPlan (2013-present), dir. Pierre Drap, is a grant from the French Agence Nationale de la Recherche titled “Ontology and Photogrammetry ; Generalizing Surveys in Underwater and Nautical Archaeology.” The ShipLAB is a partner to this project.

pp. 40-41



ForSEAdiscovery (2013-present), dir. Ana Crespo Solana, consists of the development of a dendrochronology database for the Iberian Peninsula. Marie Curie Multi-ITN project entitled “Forest resources and Ships for Iberian Empires: ecology and globalization in the Age of Discovery.” The ShipLAB is a partner to this project.

pp. 42-43



Iberian Shipbuilding Glossary (2014-present), dir. Filipe Castro and Paulo Monteiro, is a study and inventory of Iberian shipwrecks known to exist.

pp. 44-45



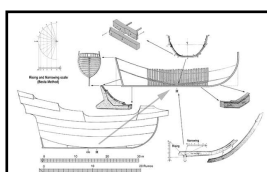
Iberian Shipwreck Scantlings (2001-present), dir. Filipe Castro, is a study and inventory of the shape and size of the timber components of early modern Iberian ships.

pp. 46-47



Iberian Shipwrecks Database (2001-present), dir. Filipe Castro and Paulo Monteiro, is a study and inventory of Iberian shipwrecks known to exist.

pp. 48-49



Early Modern Ships' Architectural Signatures (2001-present), dir. Filipe Castro, is a study and inventory of the construction features that are unique to certain shipbuilding traditions.

pp. 50-51



The Ship Iconography Database (2007-present) dir. Filipe Castro. This project is a compilation of quality images of ships from the medieval and early modern periods.

pp. 52-53



Astrolabe Database (2005-present), dir. Filipe Castro, is a study and inventory of all nautical astrolabes known to exist.

pp. 54-55



Iberian Ship Treatises Compilation (2014-present), dir. Filipe Castro and Paulo Monteiro, is a study and inventory of Iberian shipwrecks known to exist.

pp. 56-57



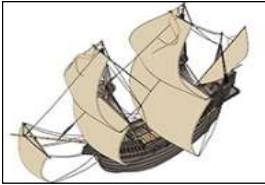
Finisterre Project (2010-present), dir. Miguel San Claudio, is a study and inventory of shipwrecks along in Galician waters.

pp. 58-59



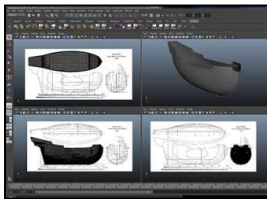
The Pepper Wreck Project (1998-present), dir. Filipe Castro was the excavation and reconstruction of the India nau *Nossa Senhora dos Mártires*, lost in 1606.

pp. 60-65



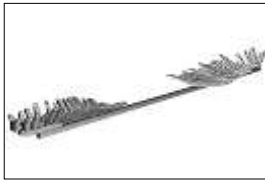
Sailing the Pepper Wreck (2006-present), dir. Filipe Castro. And Nuno Fonseca, was a continuation of the Pepper Wreck Project, testing the plausibility of our reconstruction of the India nau *Nossa Senhora dos Mártires*, lost in 1606.

pp. 66-69



Modeling the Pepper Wreck (2012-present), dir. Kotaro Yamafune and Filipe Castro. This is a continuation of previous research.

pp. 70-71



The Cais do Sodré Project, Portugal (2010-present) dir. Filipe Castro. Started in 2010, this project is the continuation of the unfinished research on this site, interrupted by the untimely death of its former director, Paulo Jorge Rodrigues.

pp. 72-73



Saveiros da Bahia Project, (2011-present) dir. Filipe Castro, and Denise Gomes Dias, studies the construction of boats following whole molding methods in S. Salvador da Bahia area, Brazil.

pp. 74-75



Battle of Itaparica, Brazil (2012-present), dir. Rodrigo Torres, a project supported by the Dutch Cultural Agency, which aims at the reconstruction of the 1643 naval battle fought between a portuguese and a Dutch fleet in the waters of São Salvador da Bahia.

pp. 76-77



The Nautical Archaeology of Puerto Rico (2007-present), dir. Filipe Castro, Richard Fontánez, and Gustavo Garcia., was a survey and an assessment of the condition of the submerged cultural heritage of Puerto Rico.

pp. 78-79



Stella 1 Shipwreck, (2010-present) dir. Massimo Capulli and Filipe Castro, started in 2011, is part of a wider study of the life along the Stella River, Italy, over a period of two millennia.

pp. 80-81



Asian Boat Models, (2015-present), dir. Filipe Castro and Kotaro Yamafune, in cooperation with Dr. Hans van Tilburg (NOAA) and Dr. Qu Jinliang (Institute of Maritime Cultures, Ocean University of China), this project aims at sharing two rare Asian boat model collections with the public via the internet.

pp. 82-83



Gnalić Project (2011-2014), dir. Irena Radic Rossi and Filipe Castro, started in 2011, the excavation of a large Venetian merchantmen lost off the Croatian coast in 1583 with a cargo bound for Constantinople.

pp. 84-87



The Lagos Project, Portugal (2006-2007), dir. Filipe Castro, was a field school in the Lagos area, consisting of a survey of the underwater cultural heritage in the region.

pp. 88-89



Playa Damas Shipwreck, Panama (2003-2005), dir. Filipe Castro was a survey of an early 16th century Spanish shipwreck site, unfortunately destroyed by treasure hunters before an excavation could be carried on.

pp. 90-91



The Arade 1 Project, Portugal (2002-2003), dir. Filipe Castro, was the excavation of a late 16th century vessel found in the 1970s on the mouth of the Arade River.

pp. 92-93



The Oeiras Guns, Portugal (2002), dir. Filipe Castro, was an emergency rescue and relocation of a cluster of iron guns, probably dated to the 18th century.

pp. 94-95

Visiting Scholars



Massimo Capulli

Massimo Capulli is Adjunct Professor of Methodology of Archaeological Research at the University of Udine, INA Research Associate, and a research scholar associated with Texas A&M University.

He received his degree in Classics at the University Ca 'Foscari of Venice, with a thesis on nautical archeology, and then studied at the Advanced School of Archaeology at Catholic University of Milan. His main interests are the history of wooden shipbuilding technology, and navigation in inner bodies of water. Over the past two decades, he has conducted field work in lakes, rivers, lagoons, and off the Italian coast. He has directed many archaeological projects, among which the excavation of the shipwrecks of Lazise, Agropoli, Rocchetta 1, Tubes, Caorle 1, Grado 2 and Stella 1.

He has also been part of the Archeomar Project, a database of the underwater archaeological Italian heritage, sponsored by the Italian Ministry of Culture, and he coordinated a Project to study the dynamics of settlement in the lagoon of Venice.

He is currently coordinator of the ANAXUM Project, to study of the history of River Stella (Northern Italy), and the SITULIS Project, which is focused on the development and preservation of the sewn or laced boatbuilding tradition in the upper Adriatic Sea in a joint venture with the Soprintendenza per i Beni Archeologici del Friuli Venezia Giulia and Veneto, and Texas A&M University.

During the Fall semester of 2014 Prof. Capulli was a visiting scholar at the J. Richard Steffy Ship Conservation laboratory at Texas A&M University, where he taught courses, presented his work, and discussed future collaboration projects.



Shipwreck dating to the 11-12th century excavated by Massimo Capulli at Precenico and being investigated and recorded at the University of Udine (Photo: Massimo Capulli)



Wendy van Duivenvoorde

Dr. Wendy van Duivenvoorde is a senior lecturer in maritime archaeology at Flinders University. Her current research is focused primarily on maritime trade and shipbuilding in the ancient Mediterranean and Northern Europe.

Dr van Duivenvoorde is an expert in late sixteenth and early seventeenth-century Dutch shipbuilding and her studies primarily focus on ships of exploration and Indiamen, and include the archaeological remains of Western Australia's Dutch East Indiamen shipwrecks. An additional research interest comprises ancient ship's fastenings and anchors. Dr van Duivenvoorde has become a specialist in the study of ship's fastenings dating to the ancient Greek and Roman periods. She has conducted research on the metal fasteners and anchors excavated from ancient Mediterranean merchantmen such as the Tektaş Burnu (±440-425 B.C.) and Kyrenia (3rd century B.C.) shipwrecks.

During the Spring semester of 2015 Dr. van Duivenvoorde was a visiting professor at Texas A&M University, and worked on several projects, including the development of a methodology to test the sailing abilities of a Dutch Indiaman and compare them with those of the Pepper Wreck, a Portuguese Indiaman build around 20 years before.

Described in detail in her book *Dutch East India Company Shipbuilding* (2015), Dutch shipbuilding was radically different from the Portuguese shipbuilding tradition.

The comparative study of these two reconstructed ships will help further our understanding of social, economical and behavioral aspects of these two competing worlds, and perhaps grasp some of the reasons behind the collapse of the Portuguese trading networks in the East and the rise of the Dutch maritime empire.

Although there is a considerable amount of literature on this matter, Dr. van Duivenvoorde believes that the study of the Portuguese and Dutch Indiamen will undoubtedly advance our knowledge of this period and its competitive commercial and political strategies towards the Eastern markets and peoples. An important aspect of this study will focus on life aboard these small floating villages, the range of “knowledges” necessary to sail the India Route, and the worldviews in which these voyages took place.



Van Duivenvoorde, W., *Dutch East India Company Shipbuilding*. College Station: Texas A&M University Press, 2015.



Maria Molina Intxaustegi

Maria Intxaustegi is an underwater archaeologist who has worked in Italy, Croatia, and Spain. In 2013 she participated in the excavation of the Delta II shipwreck, in the bay of Cadiz. Licenciada in history by the University of the Basque Country, Maria received a MA with the thesis "Europa y el mundo atlántico: Poder, cultura y sociedad," which received the V Premio Iberoamericano del Mar Cortes de Cádiz, a prestigious prize granted by the Cadiz Municipality. She is currently a PhD candidate in the University of the Basque Country. Her main research interests focus on modern age shipbuilding and she is writing her dissertation on the Havana shipyard in the 18th century.

As a visiting scholar at the ShipLAB, at Texas A&M University, Maria worked on comparative shipbuilding in 18th century Europe, studying late 17th and early 18th century treatises and shipwrecks. During her stay she visited the University of West Florida as an invited speaker.

In the 18th century Havana was the third largest city in the New World, larger than Boston and New York, and its shipyards produced vessels whose quality was praised all over the empire. Its harbors and drydock facilitated Havana's role as a hub for the movement of people, merchandises, and ideas. Maria's work will analyze the importance of Havana's shipping in the Spanish empire.



View of Havana in the 18th century (From: <http://www.aenet.org/manila-expo/page25.htm>)



Gay Lacsina

Gay Lacsina is a Museum Researcher at the Archaeology Division of the National Museum of the Philippines and a PhD candidate at Department of Archaeology at Flinders University (Australia), where she is researching Philippine pre-colonial planked watercraft. A significant part of her study focuses on the Butuan Boats which were first discovered in the 1970s, in Butuan City, southern Philippines. The incomplete remains of the Butuan Boats were discovered under about two meters of alluvial sediments. A total of six boat remains have been unearthed, including three that have been recovered and two that are still being excavated. In 2013 Philippine fieldwork, Gay measured and documented five Butuan Boats, and collected timber samples from each for wood species identification and AMS C-14 dating. The samples have since been identified to ten Southeast Asian hardwoods and were dated to between the late eighth to early tenth centuries.

As a visiting scholar at the ShipLAB, Gay has undertaken the construction of research models of the Butuan Boats, with a particular emphasis on gaining a better understanding of their fastenings, and the incredible skill and expertise needed to make them.

The Butuan Boats were shell-first built watercraft. Their planks, measuring around ten meters long were edge-joined with dowels. Of the six Butuan Boats excavated, five also exhibit another distinctive Southeast Asian construction feature, known as lashed lugs. The rectangular and protruding lugs were carved from the inside of the planks at regular intervals. When the planking was fastened, the lugs aligned with each other transversely on the vessel. The lugs were bored or drilled with holes for frames and thwarts to be lashed, and functioned similarly to cleats of Viking ships. Southeast Asian boat builders constructed lashed-lug boats from as early as the fifth century and in remote parts of the region until at least the 1980s.



One of the Butuan boats (Number 1) in the Balangay Shrine Museum.

Ongoing Graduate Work



Samila Ferreira (PhD, 2013-)

Policies of Memory, Politics of Forgetting

Samila Ferreira is a Doctorate Student at the Cultural Anthropology Program. She graduated with a B.A. in History from the Federal University of Rio Grande, Brazil in 2008, and with a M.A. in Social Memory and Cultural Heritage from The Federal University of Pelotas, Brazil in 2010. Her Master's thesis discusses concepts of cultural heritage, social memory, public policy, and the invention of traditions. During her career she has been focusing her research efforts primarily on studying the relation between social memories, cultural heritage and the effects of public policies on the representation/oblivion of social groups in heritage preservation projects. Her empirical work has been carried out in the historical port town of São Lourenço do Sul, southern Brazil. Her doctoral research proposal will undertake a comparative study of this theme in Brazil and in the US.

Pages 98-99



Nick Budsberg (PhD, 2011-)

Ships of Discovery and the Renaissance

Nicholas Budsberg is a doctoral student in the Nautical Archaeology Program where he is studying the maritime impacts of the European expansion. His research focuses on the Spanish and Portuguese vessels that first charted and explored the African coast and the New World, and that would later be the first to circumnavigate the globe. Nicholas's current focus is the re-investigation of possibly the earliest European shipwreck site in the New World located off of the coast of Highbourn Cay in the Exumas, Bahamas. Nicholas received his Bachelor of Arts in Anthropology with an Archaeology Concentration from Western Washington University in 2010. His field work and experience has been mostly accumulated in the Balearic Islands, Spain, and in the Aucilla River, Florida, while during the academic year he is an officer with the Archaeology Dive Club, and the Nautical Archaeology Student Association. He is an L.T. Jordan International Fellow, holds a Graduate Assistant -Teaching position, and is the recipient of several other internal and external grants and scholarships. He is currently finishing his coursework in College Station, Texas, while he will be working with the Bahamian government on shipwreck, conservation and cultural heritage projects.

Pages 102-103



Samuel Cuellar (PhD, 2011-)

A History of Ship Bells

Sam Cuellar completed his BA in Anthropology at Texas A&M University in Spring of 2011 and began his graduate studies at Texas A&M's Nautical Archaeology Program (NAP) in Fall of 2011. Sam's dissertation work focuses on the first study undertaken of the origins, history, and uses of early ship bells dating up until the beginning of the 18th century. Fieldwork for his dissertation will take place in Europe over the Summer of 2014, and involve the examination of numerous ship's bells in private collections and museums, as well as additional archival research. Sam's current fieldwork includes assisting in the excavation of the Gnalic shipwreck off the coast of Croatia. During his graduate career, Sam has developed interest in the relationship between underwater archaeologists and offshore oil and gas drilling in the Gulf of Mexico through work with Texas Nautical Archaeologist Amy Borgens. He plans to develop ways to enhance the relationship between the academic and business sides of underwater archaeology to increase information sharing and cooperation.

Pages 100-101



Randall Sasaki (PhD, 2008-)

The Bach Tang Excavation, Vietnam

Randall J. Sasaki was born and raised in Japan, but moved to U.S. to complete his B.A. in Anthropology (specializing in Indian Ocean Seafaring in the Bronze Age) at Southwest Missouri State University (currently Missouri State University). After working as a field supervisor at several CRM companies, he decided to pursue an academic career in Nautical Archaeology with a focus on East Asian Seafaring. While in the Nautical Archaeology Program at Texas A&M University, he was involved with a number of maritime archaeological projects in Japan. He completed his MA in 2008. His MA thesis focused on the reconstruction of the ill-fated Mongol fleet that was destroyed by "the divine wind" at the battle of Koan in 1288. He is currently conducting field work in Vietnam, aiming to find another ill-fated Mongol fleet in that country. He is the author of the books *The World History Based on Shipwrecks* (Media Factory/New Book Series. Tokyo, Japan, 2011), *The Archaeology of Kamikaze: Revealing the Secret of Mongolian Navy* (Texas A&M Press, in final review).

He is currently working as a city archaeologist at Fukuoka Japan while completing his PhD Dissertation.

Pages 104-105

Ongoing Graduate Work



Sanghita Bandyopadhyay (MA, 2015-)

Identifying and cross-verifying subject matter expertise within LinkedIn

Sanghita Bandyopadhyay is a graduate student at the Department of Computer Science and Engineering. She graduated with a B.Tech degree in Computer Science from National Institute of Technology, Rourkela, India. Her master's thesis is based on analysing massive amounts of data obtained from the public domain and predicting expertise after analysing the same. It discusses the limitations of the search feature provided by LinkedIn and aims at enhancing the same. The focus of her work is to accurately predict of expertise of a person based on information obtained from their public profiles when a particular keyword is provided as input. The data is being obtained by scraping is further organised it into reusable structures. These structures would be further analysed to extract meaningful information. An added step in the algorithm would be to verify the information of the individuals from other trusted sources to improve the veracity of the results.



Matt Suarez (MA, 2015-)

Computer Aided Modeling In Archeology

Matt Suarez is working on a parameterized model of a 16th century ship and exploring the possibility of defining 3D hull shapes using Houdini. Through a process of implementation and evaluation of prototype tools, Matt wants to attempt to create a procedural modeling utility for use in nautical archaeological ship reconstruction research, the usefulness of which will be evaluated on a real example. His approach entails the development of a taxonomy, the definition of parameters and relationships based on the taxonomy created, and the implementation through prototyping.

**Chethna Kabeerdoss (MA, 2015-)***Modeling a shipwreck*

Chethna Kabeerdoss is Chethna Kabeerdoss is currently a second year graduate student in the M.S Visualization program at Texas A & M University, Department of Visualization. She specializes in creating digital effects, procedural rigging and problem solving for computer animation. She enjoys developing creative solutions for technical challenges pertaining to the computer graphics workflow.

For her thesis she is looking at deconstructing an oceangoing wooden ship and simulating a dynamic collapse mechanism that describes reality as closely as possible.

Completed Graduate Work



Kotaro Yamafune (PhD, 2012-2015)

Using Computer Vision Photogrammetry (Agisoft PhotoScan) to Record and Analyze Underwater Shipwreck Sites.

pp. 108-109



Rodrigo Torres (PhD, 2010-2015)

The Archaeology of Shore Stranded Shipwrecks of Southern Brazil.

pp. 110-111



Charles Justus Cook (MA 2010-2011, Visualization Sciences Department, Texas A&M University)

Committee Chair: Frederic Parke

A Parametric Model of the Portuguese Nau.

pp. 112-113



Chris Cartellone (PhD, 2009-2015)

H.M.S. Solebay and Maritime Archaeological Heritage Preservation in Nevis, West Indies.

pp. 114-115



Kotaro Yamafune (MA, 2009-2012)

The Portuguese Century in Japan and the Namban Screens.

pp. 116-117



Kelby Rose (PhD, 2008-2014)

Reverse Naval Architecture of Vasa, a 17th-Century Swedish Warship.

pp. 118-119



Coral Eginton (MA 2008-2014)

Dutch ship pharmacies.

pp. 120-121



Laura Gongaware (MA 2006-2013)
Treasure Hunting: Three Case Studies.

pp. 122-123



Paul Creasman (PhD 2006-2010)
Extracting Cultural Information from Ship Timbers.

pp. 124-125



Lilia Campana (MA 2006-2010)
Vettor Fausto (1490-1546), Professor of Greek and Naval Architect: a New Light on the 16th-Century Manuscript Misura Di Vascelli Etc. di...Proto Dell'Arsenale di Venetia.

pp. 126-127



Carlos Monroy (PhD 2006-2010, Computer Science Department, Texas A&M University),
Committee Chair: Richard Furuta
A Digital Library Approach in the Reconstruction of Ancient Sunken Ships.

pp. 128-129



Audrey Wells (MA 2006-2008, Visualization Sciences Department, Texas A&M University)
Committee Chair: Frederic Parke
Virtual Reconstruction of a Seventeenth-Century Portuguese Nau.

pp. 130-131



Bryanna Dubard (MA 2005-2013)
The Key to All the Indies: Defense of the Isthmus of Panama .

pp. 132-133



Courtney Higgins (MA 2005-2012)
The Venetian Galley of Flanders: from Medieval 2-Dimensional Treatises to 21st Century 3-Dimensional Model.

pp. 134-135



Vincent Valenti (MA 2005-2009)

Transitions in Medieval Mediterranean Shipbuilding: A Reconstruction of the Nave Quadra of the Michael of Rhodes Manuscript.

pp. 136-137



Sarah Kampbell (MA 2004-2007)

The Pantano Longarini Shipwreck: A Reanalysis.

pp. 138-139



Hiroaki Miyashita (MA 2004-2006)

Ancient Ships of Japan..

pp. 140-141



George Schwarz (MA 2003-2008)

The History and Development of Caravels.

pp. 142-143



Blanca Rodriguez (MA 2003-2008)

Standardization of Spanish Shipbuilding: Ordenanzas para la Fabrica de Navios de Guerra y Mercante - 1607, 1613, 1618.

pp. 144-145



Randall Sasaki (MA 2002-2008)

The Origin of the Lost Fleet of the Mongol Empire.

pp. 146-147



Tiago Fraga (MA 2002-2007)

Santo António de Tanna: Story and Reconstruction.

pp. 148-149



Timothy Kane (MA 2002-2006)

Influence and Evolution: The Development of the Batten Lug Sail.

pp. 150-151



Alex Hazlett (PhD 2001-2007)

The Nao of the Livro Nautico: Reconstructing a Sixteenth Century Indiaman from Texts.

pp. 152-153



Gustavo Garcia (MA 2000-2005)

The Rincón Astrolabe Shipwreck.

pp. 154-155



Katie Custer (MA 2000-2004)

Wrought Iron Hand Tools from the Underwater Archaeological Excavations of Colonial Port Royal, Jamaica, C. 1692.

pp. 156-157



Erika Laanela (MA 1999-2008)

Instrucción Náutica (1587) by Diego García de Palacio: an Early Nautical Handbook from Mexico.

pp. 158-159

Research Interests



RESEARCH INTERESTS

Computers and the Dissemination of Knowledge

2005-present

In Cooperation with the Center for the Study of Digital Libraries

Computers have the potential to make underwater excavations cheaper, faster, more detailed and more accurate. They can store each excavation phase and produce highly composite 3D virtual models from each freshly excavated and exposed surface, long after they have been impacted by the excavation process. Moreover, 3D models can be shared in real time and associated with all sorts of information layers, allowing people to leave comments and reflections on them, and allowing researchers to mine the comments and increase the social value of archaeology as a discipline than can help different people understand the plurality of narratives about our common past.

Publications

Monroy, C., Castro, F., and Furuta, R., "Synthesizing and Storing Maritime Archaeological Data for Assisting in Ship Reconstruction", in A. Catsambis, B. Ford and D. Hamilton, eds., *Oxford Handbook of Maritime Archaeology*, Oxford: Oxford University Press, 2011: 327-346.

Monroy, C., Furuta, R., and Castro F., "Using an Ontology and a Multilingual Glossary for Enhancing the Nautical Archaeology Digital Library". *Joint Conference on Digital Libraries JCDL*, Queensland, Australia, 2010, pp. 259-262.

Monroy, C., Furuta, R., and Castro F., "Ask Not What Your Text Can do For You. Ask What You Can do For Your Text (a Dictionary's perspec-

tive)" *Digital Humanities 2009*, College Park: University of Maryland, 2009: 344-347.

Monroy, C., Furuta, R., and Castro, F., "Design of a Computer-based Frame to Store, Manage, and Divulge Information from Underwater Archaeological Excavations: the Pepper Wreck Case," in Castro, F. and Custer, K., eds., *Edge of Empire. Proceedings of the Symposium held at the 2006 Society for Historical Archaeology Annual Meeting, Sacramento, California*, Lisbon: Caléidoscópio, 2008.



Aspect of a 3D model of the Gnalic Shipwreck
(Kotaro Yamafune and Rodrigo Torres)

Monroy, C., Furuta, R., and Castro, F., "A Multilingual Approach to Technical Manuscripts: 16th and 17th-century Portuguese Shipbuilding Treatises," Edie Rasmussen (Chair) *Proceedings of ACM/IEEE Joint Conference on Digital Libraries*, Vancouver, BC, Canada, 2007: 413-414.

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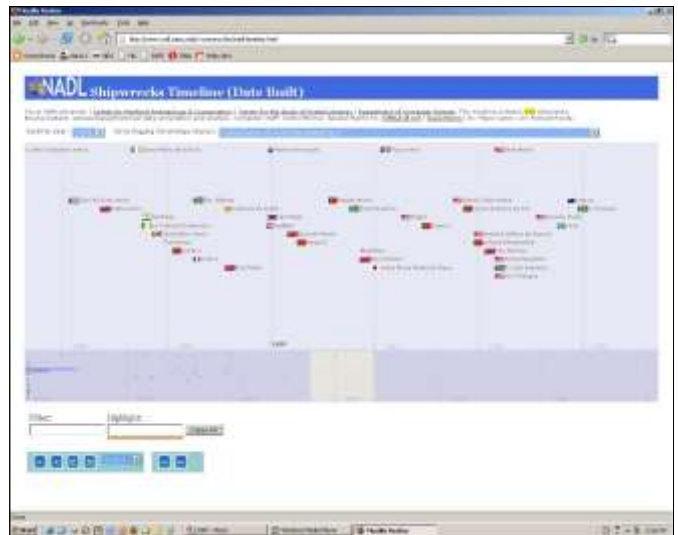
Communications at International Meetings

Monroy, C., Furuta, R. and Castro, F. *Digital Integration of Shipbuilding Treatises and Ship Fragments in the Reconstruction of Ancient Sunken Ships*, at the 39th Annual Meeting of the Society for Historical Archaeology Annual Conference, Williamsburg, VA, January 2007.

Monroy, C., Furuta, R. and Castro, F. *Design of a Computer-based Frame to Store, Manage, and Divulge Information from Underwater Archaeologi-*



Screen of the Nautical Archaeology Digital Library (Carlos Monroy).



Timeline screen of the Nautical Archaeology Digital Library (Carlos Monroy).

cal Excavations: the Pepper Wreck Case 38thSociety for Historical Archaeology Annual Meeting, Sacramento, California, 2006.

Graduate Work

Carlos Monroy, *The Nautical Archaeology Digital Library* (PhD 2005-2009 – Chair: Richard Furuta, Department of Computer Science, Texas A&M University).

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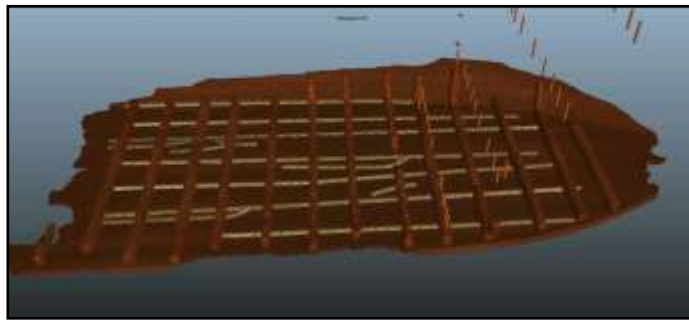
Ship Modeling and Computer Graphics

2004-present

A cooperation between the Department of Visualization, Texas A&M University, and Centre for Marine Technology and Engineering, Instituto Superior Técnico, Lisbon, Portugal.

During the last four decades computers have continuously changed the way archaeologists work. The ShipLAB works with the Department of Visualization, Texas A&M University and the Centre for Marine Technology and Engineering of Instituto Superior Técnico, to maximize our research capacity and to profit from the important input of these two institutions.

Numerical and graphic models can be a useful aid when archaeologists are trying to reconstruct a vessel from its archaeological remains. Although the traditional wooden models are still an important part of the research, computers have considerably simplified the process by allowing archaeologists to engage in an iterative process, where mistakes are a lot easier to correct. Moreover, 3D printers allow archaeologists to produce physical models from computer graphic models.



Remains of the Roman laced boat Stella 1.
(Kotaro Yamafune)

About our Work

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Castro, F., *Computers and Shipwrecks: The Pepper Wreck Reconstruction as a Virtual Hypothesis*,

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Castro, F., Fonseca, N., Loureiro, R. and Santos, T. *The Pepper Wreck - Nossa Senhora dos Mártires, 1606: update on the virtual reconstruction of a Portuguese India nau*. XIV International Reunion for the History of Nautical Science, Coimbra, Portugal, October 23-25, 2008.

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Castro, F., N. Fonseca and T. Santos. *Estudo das características náuticas de uma nau de 600 tonéis da Carreira da Índia (paper delivered by Dr. Nuno Fonseca)*. Academia de Marinha, Lisbon, Portugal, November 2007.

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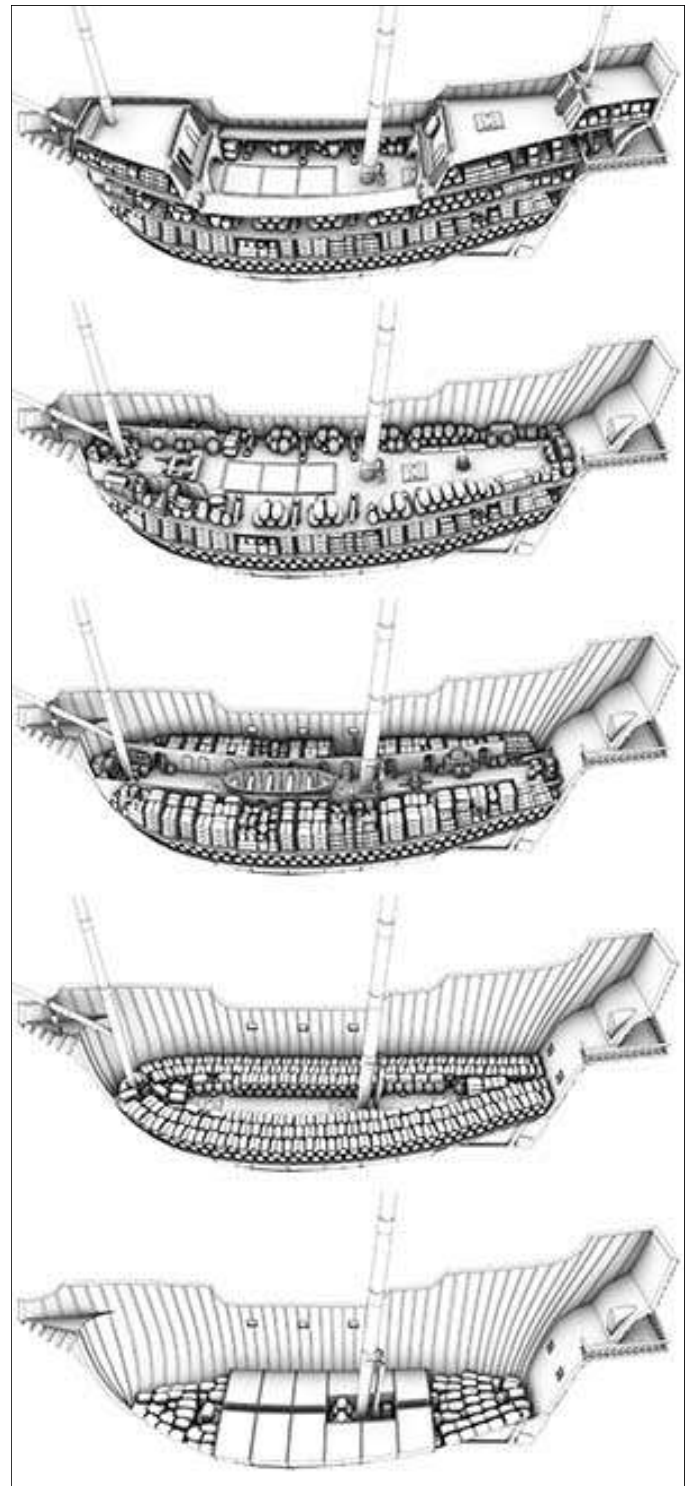
T. Santos, N. Fonseca, T. Vacas, and Castro, F. *Numerical Simulations of Indian Route Voyages by the Late 16th Century Portuguese Indiamen*, 43rd Annual Meeting of the Society for Historical Archaeology Annual Conference, Austin, Texas, January 2011.

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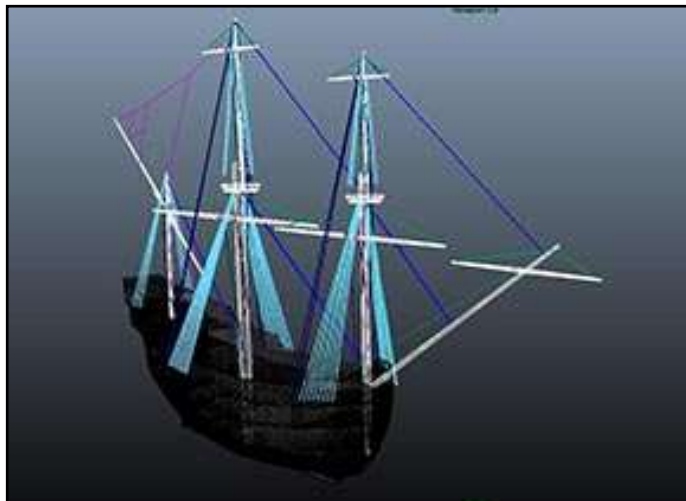
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Cargo Distribution aboard the Pepper Wreck at departure from India (Audrey Wells).

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Rigging model of the Pepper Wreck (Kotaro Yamafune)

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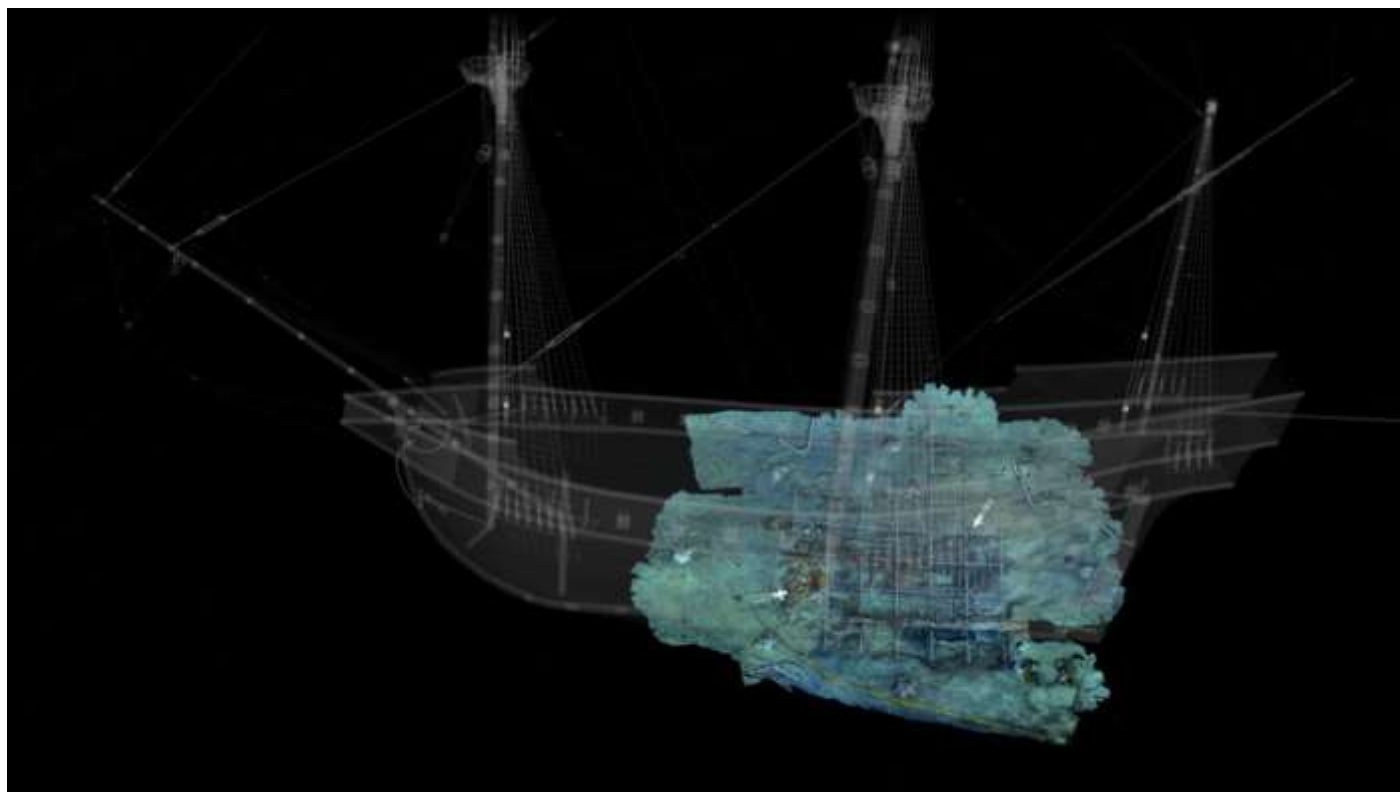
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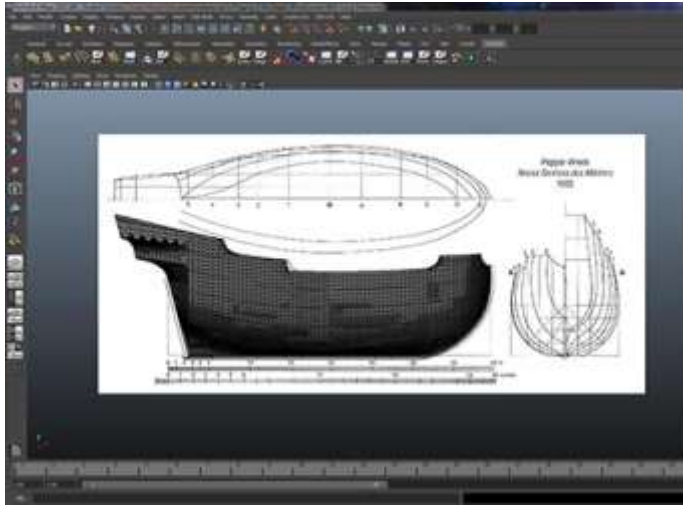
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Graduate Work

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The shipwreck at Gnalčić and a hypothetical original position of the ship immediately after its loss. (Kotaro Yamafune)



Model of the Pepper Wreck (Kotaro Yamafune)

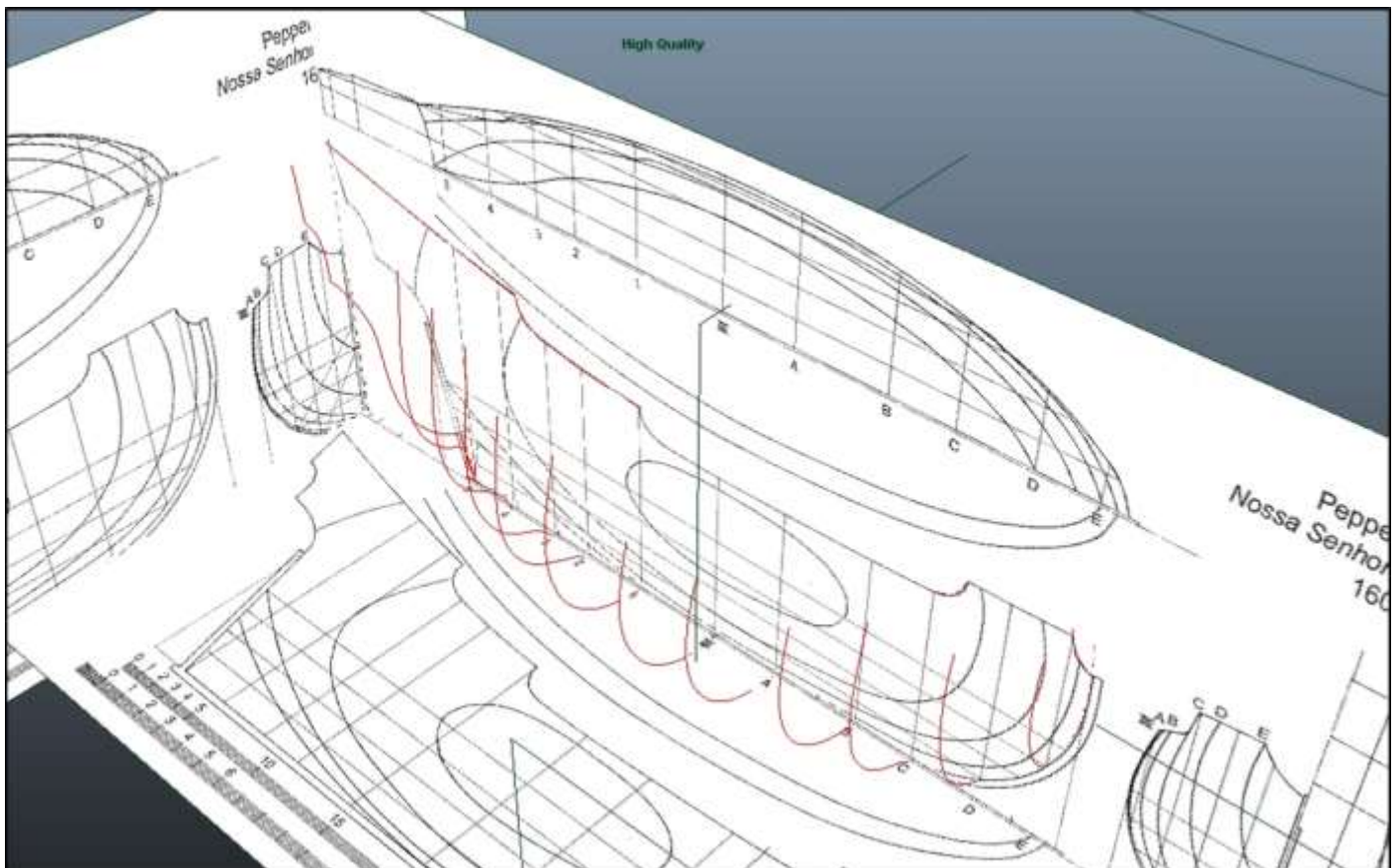
Kotaro Yamafune, *Tridimensional Reconstruction of a 17th Century Merchantman* (PhD 2012-).

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Kelby Rose, *A Three-Dimension Study and Reconstruction of Vasa* (PhD 2008-).

Charles Justus Cook, *A Parametric Model of the Portuguese Nau*. (MA 2010-2011 – Chair: Frederick Parke, Department of Visualization, Texas A&M University).



Model of the Pepper Wreck (Kotaro Yamafune)

RESEARCH INTERESTS

Submerged Cultural Heritage

1996 - present

The ShipLAB condemns the destruction of the underwater cultural heritage by looters and treasure hunters. We believe that treasure hunters and archaeologists cannot work together because our activities have different objectives. The goal of treasure hunting is profit. It is understandable that its investors expect the best return for their investments. A for-profit company that allocates time to carefully excavate an archaeological site, or spends money to preserve artifacts without market value, will be replaced by any company with a more efficient focus on the extraction and sale of artifacts that possess market value.

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Castro, F., *2010 Summer Season in the Upper Adriatic Region*, Brown Bag Talks, Anthropology Department at Texas A&M University, October 2011.

Castro, F., *Dendrochronology and the Ships of the Age of Exploration*, Meeting of the Iberian Heritage Project - Filling the Blanks in European dendrochronology: building a multidisciplinary research network to assess Iberian wooden cultural heritage worldwide. The Netherlands Organization for Scientific Research, Nederlands Centrum voor Dendrochronologie, Amersfoort 16-17 September 2011.

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Castro, F., Gulf Coast Maritime Archaeological Database Workshop, Texas A&M University, Texas, Invited by the National Oceanic and Atmospheric Agency. May 7-8, 2003.

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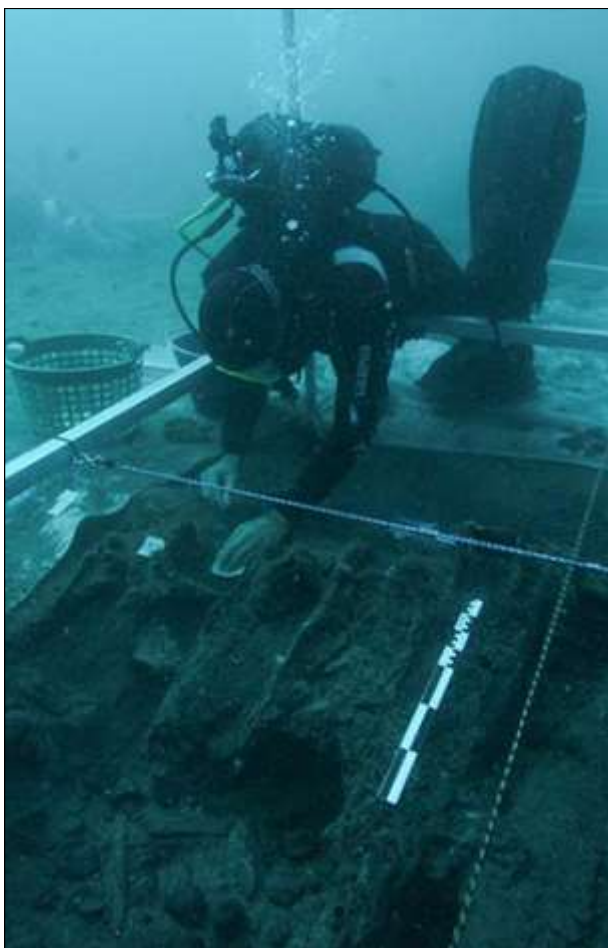
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Working on the Gnalić Shipwreck
(Photo: S. Govorcin, 2012)

Fraga. Eastern Cape, South Africa, 7-9 Aug. 2004.

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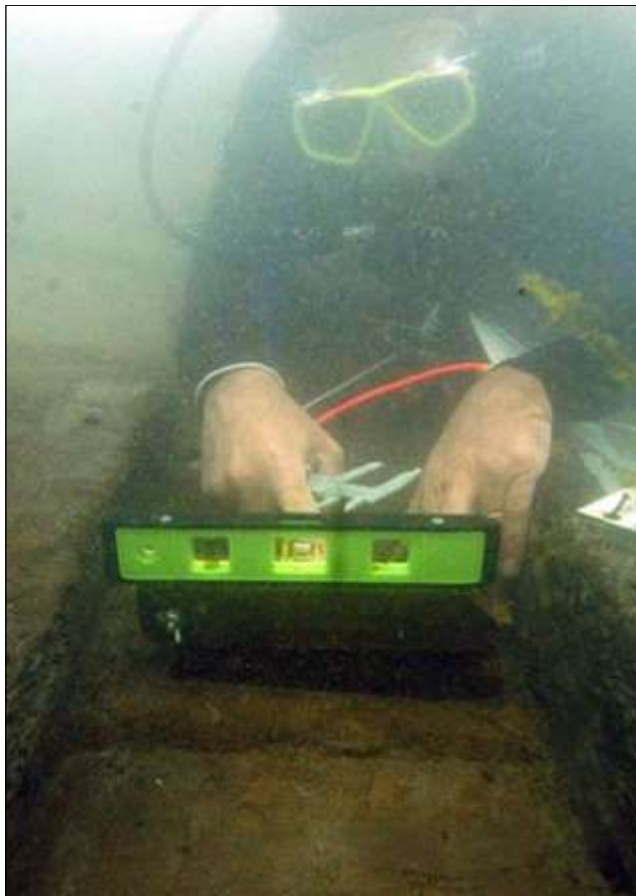
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Working on the Stella 1 shipwreck (Photo: M. Capulli 2012)

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Laura Gongaware, *Treasure Hunting: Three Case Studies* (MA 2006-2013).

Pearce Paul Creasman, *Extracting Cultural Information from Ship Timbers* (PhD 2005-2010).

Katie Custer, *Wrought Iron Hand Tools from the Underwater Archaeological Excavations of Colonial Port Royal, Jamaica, C. 1692* (MA 2000-2004).

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Early 16th century shipwreck before being salvaged by treasure hunters in Madagascar. The copper ingots, some bearing the mark of the German family Fugger, were sold as scrap metal and the bronze guns apprehended in Djibouti .

(Photo: Alexis Rosenfeld).



Early 16th century Spanish shipwreck before being salvaged by a treasure hunting company named IMDI—Investigaciones maritimas del Istmo. No reports or images have been published after the salvage works.

(Photo: Karl Vandenhoe, Spiegel TV)

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Most times, after a salvage company destroys a shipwreck to salvage artifacts with market value, the only thing remaining is a website or an auction catalog with images of the artifacts sold, like in the case of the supposed Portuguese ship São José, salvaged by a treasure hunting company named Arqueonautas Worldwide.

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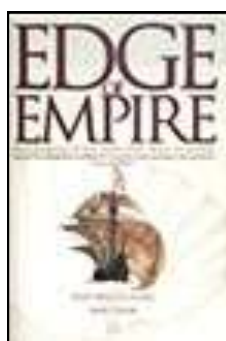
Cover of an auction catalog with artifacts from a shipwreck salvaged by Arqueonautas Worldwide in Mozambique.

RESEARCH INTERESTS

Iberian Seafaring

2001 - present

Portuguese and Spanish ships of the 15th and 16th centuries were among the best in the world during this Iberian golden age. Building upon the work developed by the Institute of Nautical Archaeology in the late 1980s and early 1990s, the ShipLAB has continued to collect data and study these ships, their voyages, and the peoples that built and manned them.



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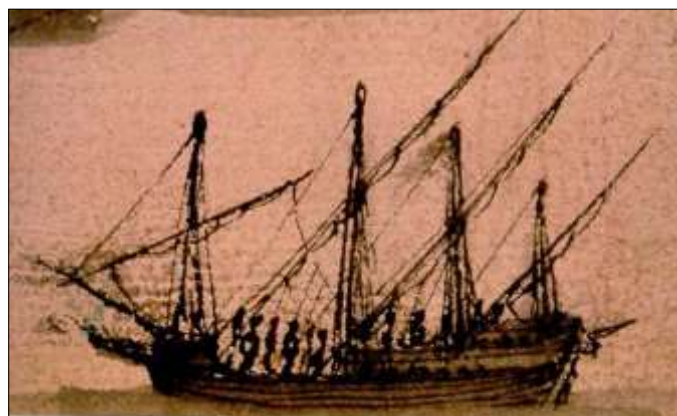
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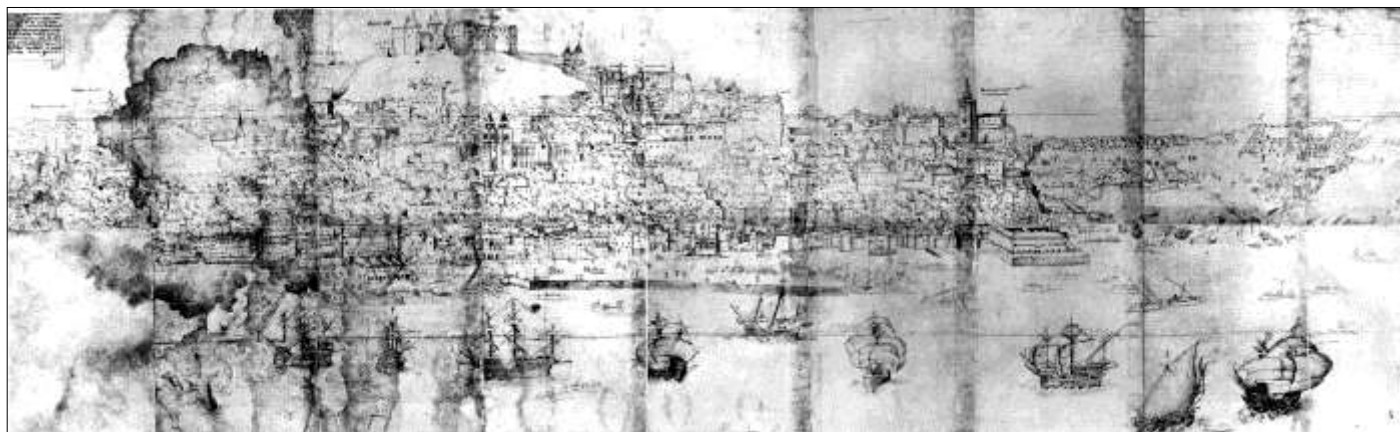
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Portuguese Carracks off a Rocky Coast, unknown author, possibly Joachim Patinier, c. 1527.



Leiden View of Lisbon, unknown author, c. 1535.

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Research:

Projects

PROJECTS

Recording and Reconstructing Ship Remains.

2012 - present

P.I.: Pierre Drap

This is a project funded by the Agence Nationale de Recherches - Programme Contenus Numériques et Interactions : « Généralisation du Relevé, avec Ontologies et Photogrammétrie, pour l'Archéologie Navale et Sous-marine ».

Underwater archaeology as a research discipline is a nexus between the soft and hard sciences. The problem of recording underwater sites is at the center of every project. Digging is time consuming, expensive, and a sometimes dangerous and destructive process. Archaeologists typically destroy the archaeological sites they dig; therefore accurate and comprehensive recording is the most important task of any project.

Archaeologists must know what to measure and measure it as accurately as possible, but their responsibility does not end here. They must store and share their data with their peers, and make sure it is accessible to other scholars in the future.

Ensuring that knowledge and accuracy are the foundations of any recording process, **Pierre Drap**, a world renowned computer scientist, developed software that automatically acquires archaeological information from photogrammetric images, and creates an extremely accurate cloud of points with color metadata that represents an excavated surface chosen by the archaeologists at any given moment, .



Figure 1 - Photogrammetric image of a section of a shipwreck (Pierre Drap, Gnalić, 2012).

With a modest participation of the ShipLAB, the Images and Models team (I&M) from the Laboratory of Sciences of Information and Systems at Marseilles (LSIS), UMR CNRS 7296, is developing a new technology to automate the process of volume recognition.

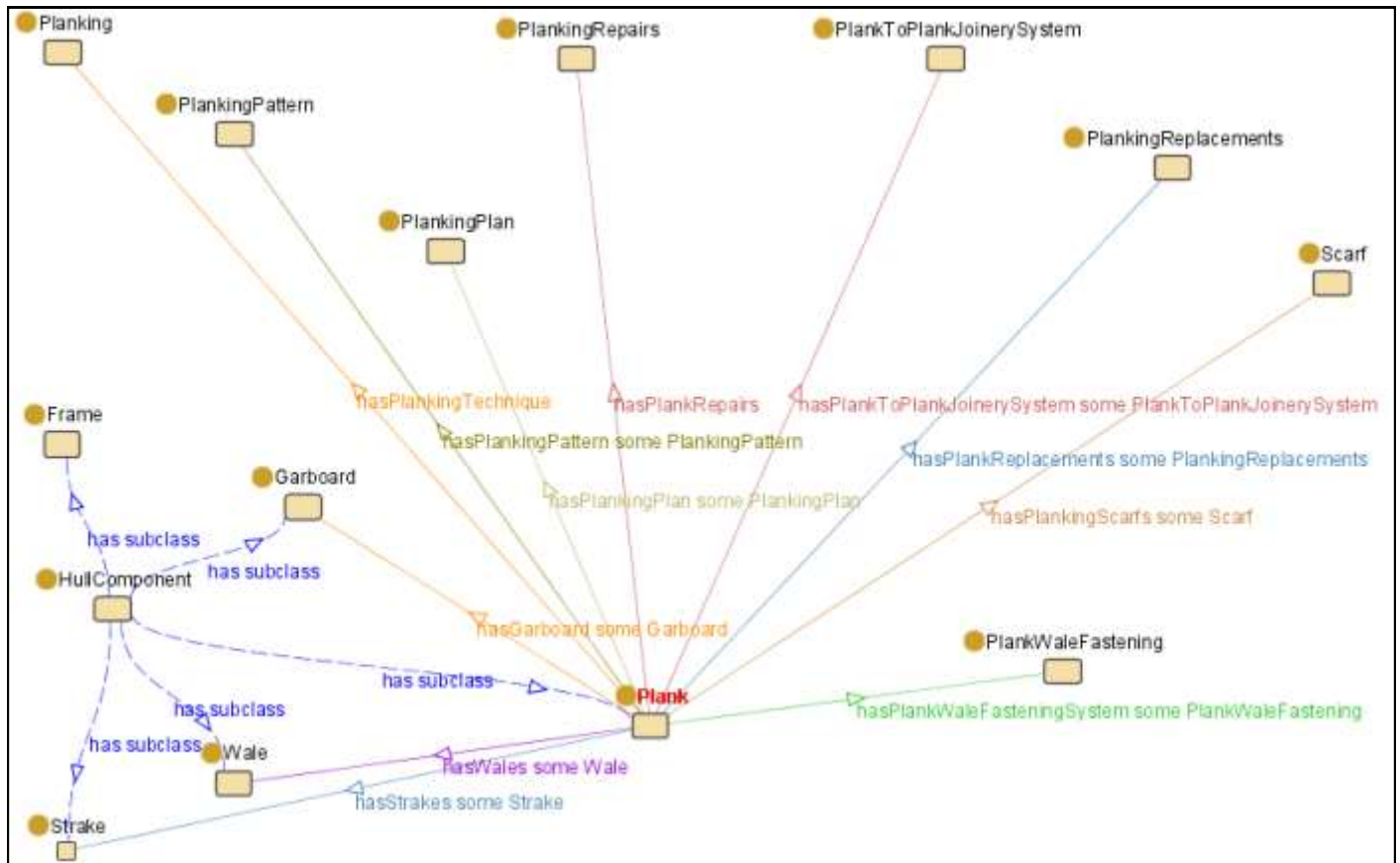
In other words, to try to automate the process from Figure 1, to Figure 2, to Figure 3. To identify the structural components of a shipwreck is not a trivi-

al endeavor. We are developing this project along two lines of research, namely the relations between measurement/knowledge and photogrammetry/ontology, within the context of naval archaeology, where measures are often incomplete, as well as in underwater archaeology, where the aim is to develop sophisticated pattern recognition 3D/2D, which then proposes or validates typological assumptions from very precise measurements.

The survey of the current state of this shipwreck will be achieved through an automated process, departing from the recognition and localization of amphorae and other manufactured objects visible on the surface layer.

A complete and detailed ontology, already initiated at Texas A&M University, will describe the structural elements of the vessel and propose a generalization of the relation measurement/knowledge which is proposed in the context of naval archaeology.

This project is titled *Généralisation du Relevé, avec Ontologies et Photogrammétrie, pour l'Archéologie Navale et Sous-marine*, and is a cooper-



Carlos Monroy's Ship Ontology, showing the topics and relations that populate the databases we are in the process of building.

ative effort of the Laboratoire des Sciences de l'Information et des Systèmes, UMR 7296, the Centre Camille-Jullian, UMR 7299, the companies COMEX and Société d'Etudes et de Travaux Photogrammétrique (STEP), the ShipLab and the University of Malta.

The project is based on a survey of an exceptional deep water shipwreck in Malta (located 110m deep and probably the oldest shipwreck archaic central Mediterranean) which requires complete automation of the survey phase, using robots. The survey of the current state of this shipwreck will be achieved through an automated process, departing from the recognition and localization of amphorae and other manufactured objects visible on the surface layer. To achieve this full automation objective we will develop an original approach of underwater photogrammetry to be deployed from a specific instrumental complex implemented with the resources of the company COMEX. This photogrammetric approach is supported by a body of archaeological knowledge formalized in an ontology,

both from the points of view of theoretical and geometrical conception of the artifacts and components involved, within the ontology developed - trades will be implemented to support and guide the process of measurement and exploitation of this measure. In a second step, we will initiate a process of generalization of this approach to the body of naval archeology through several particular case study. The relation measurement/knowledge will be studied in the context of a naval archeology in collaboration with Texas A&M University which on one hand has already start working to formalize structural element of vessel and on the other hand led various archaeological excavations in the Mediterranean on this topic. A more complete and detailed ontology, already initiated at Texas A&M University, will describe the structural elements of the vessel and propose a generalization of the relation measurement/knowledge is proposed in the context of naval archeology

PROJECTS

ForSEAdiscovery

2011 –present

P.I.: Ana Crespo Solana, Consejo Superior de Investigaciones Científicas,
Madrid.

This is a Marie Curie Multi-ITN project entitled “Forest resources and Ships for Iberian Empires: Ecology and Globalization in the Age of Discovery.”

This project aims at the development of a dendrochronological series for the Iberian Peninsula. The ShipLAB participates as a Partner and its input in this project is related to the development of a database of Iberian Shipwrecks of all ages and collaboration in the sampling process, in what pertains to timbers from shipwrecks, and timbers in any way related to the shipbuilding process.

The ShipLAB contribution to this project is divided into five subjects, all pertaining to the importance of timber in the construction of ships.

The types and ages of trees, the places where, and the times when they are cut, the processes by which certain trees are chosen, marked, cut down, transformed, transported, stored, and ultimately converted into ship components, all these factors are important in the shipbuilding process.

Our contribution will entail the development of the following five projects:



Nau from Livro de traças de carpintaria, de Manoel Fernandez, dated to 1616.

A ship in parts. Glossary

This project will be based on a series of drawings representing the construction sequence of a Portuguese *nau*, developed by Alexander Hazlett that will be adapted to support a glossary with the names of the component timbers, areas, and spaces indicated in several languages, including Portuguese, Spanish, French and English.

The shipwreck files

After defining a model of a fiche to describe Iberian shipwrecks with timber remains, the ShipLAB will develop a compendium of published Iberian shipwrecks around the world. This project will partly integrate the doctoral dissertation of Nick Budsberg.

For commodity of treatment, each text will be organized along a fixed structure. These files will be integrated in a GIS database developed by ForSEAdiscovery, as one of the outcomes of this grant.

The shipwreck database

This project will be developed in cooperation with the Portuguese Instituto de Arqueologia e Paleociências (IAP), and the Spanish archaeologist Miguel San Claudio, and will aim at identifying bibliography, collect pictures and measurements, and information on published and unpublished late

medieval and early modern shipwrecks found in Portuguese and Spanish waters.

Architectural signatures

This project consists of an inventory of construction features found in Iberian shipwrecks, ship images, and ship descriptions., which are not common on other shipbuilding traditions.

The shipwreck image database

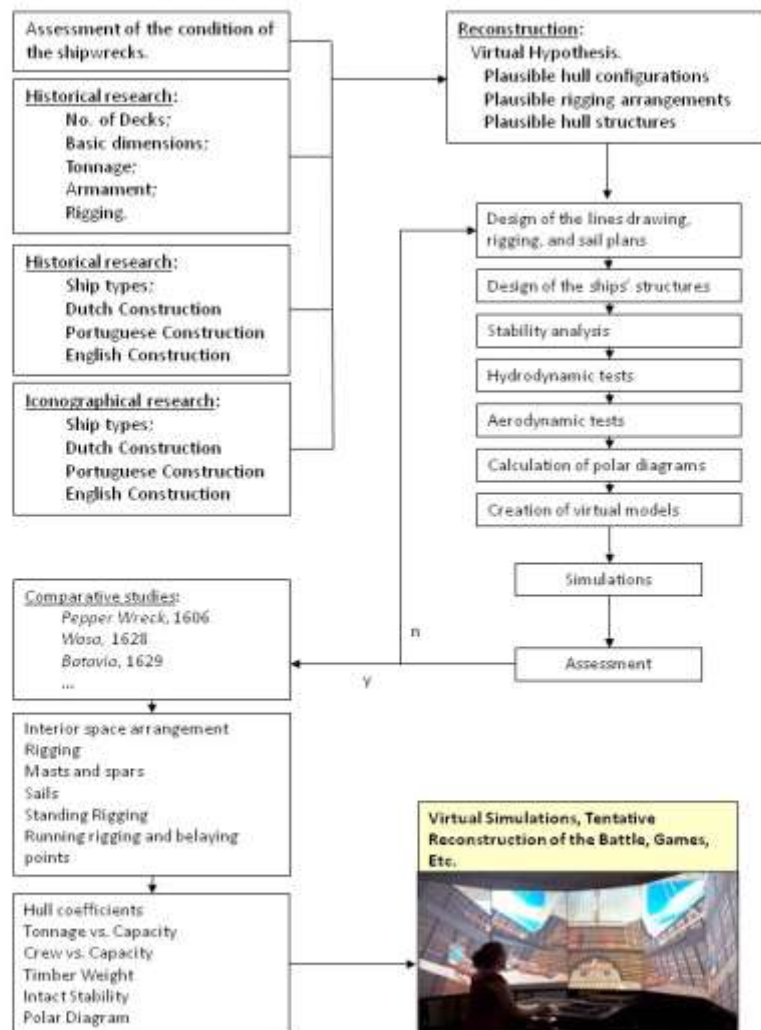
This project will be developed in the ShipLAB, in cooperation with Portuguese Instituto de Arqueologia e Paleociências and Miguel San Claudio, and consists of a collection, as exhaustive as possible, of information about iconography of Iberian ships.

The study of ship timbers and scantlings is the basis for any study of shipbuilding in Portugal, in the 16th century. Combined with historical and archaeological research, it will allow us to find patterns and construction traits, which may in the near future be useful to estimate de provenience and size of a shipwreck, based on sometimes scanty acrchaeological remains.

With help of computers, large dimensional databases can be developed, and this information compounded and filtered through the input of iconographial and historical documents, and help scientists reconstruct the ships of this imporatant seafaring period.

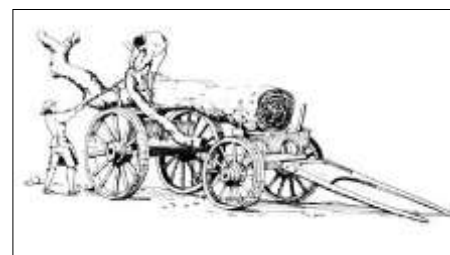
Over the last decade we have collected an important amount of data, which we expect to use and expand, using the model presented in the flow chart on this page.

One of the expected outcomes of this project is a better understanding of questions such as the management of forrests in the late 15th and early 16th centuries, the process of acquiring suitable timber for shipbuilding, and the constraints placed



Flow chart showing the iterative process implicit in our model.

on shipbuilding by the avalibility, or lack of it, of good timber for shipbuilding.



Timber transport was difficult and expensive, and trees were prepared in the forests, before being transported to the shipyards.

PROJECTS

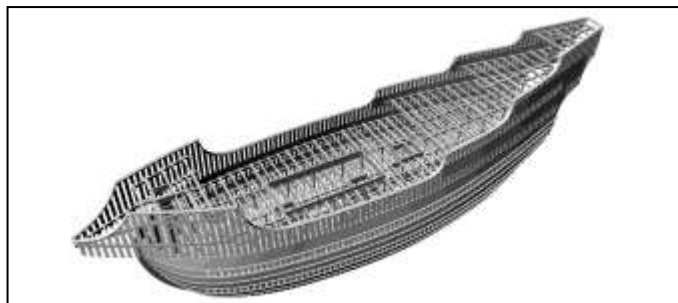
A Ship in Parts

2011 - present

P.I.: Filipe Castro

The ShipLab is working on a glossary for shipbuilding terms of the late medieval and early modern periods, trying to clarify some terms and expressions appearing in old texts on shipbuilding,. These include contracts and technical texts in Portuguese and Spanish. Because so many words have Mediterranean origins, we are collecting texts and glossaries in several languages and trying to relate them.

This project is now part of the ForSEAdiscovery Project, and we expect to produce a multi-lingual glossary for 16th century shipbuilding and complement it with scholarly work that clarifies terms and expressions difficult to understand in some particular contexts.



Structural model by Tom5s Vacas (2009) with all the timbers necessary to built the structure of a Portuguese Indiaman, according to the shipbuilding texts of *Livro náutico* (late 16th century).

A 3D model of an hypothetical 16th century ship will be developed, based on the structural models developed by Alex Hazlett and Tomás Vacas, and a number of screen captures with be selected to be tagged with the names of the component timbers. When necessary, individual timbers will be modelled and tagged as well. The end product should be a series of drawings of a typical early modern Iberian ship presenting a construction sequence and an exhaustive description of the ship's parts and timber components.

The glossary will be designed as a potential base for the development of an ontology, and the words will be organized according to a taxonomy encom-

passing the following categories: ship types (e.g. caravel, galleon, nao, urca), ship toponymy (hold, deck, hatch, castle), ship structure components (keel, floor timber, stringer, stem post), ship fittings (capstan, windlass, knightheads, bitts), ship rigging (shroud, sheave block, mast, yard), and sailing vocabulary (fore, aft, beating, reaching).

The study of old technical texts on shipbuilding depends on a clear understanding of the vocabulary and its regional and sometimes localized meanings. The ForSEAdiscovery team is gathering iconography of ship components as well, in order to build a library that we hope can clarify the meaning of contracts and descriptions. During the Fall of 2014 and Spring of 2015, the ForSEAdiscovery team entered a number of glossaries in a database that will serve as a basis for future studies.

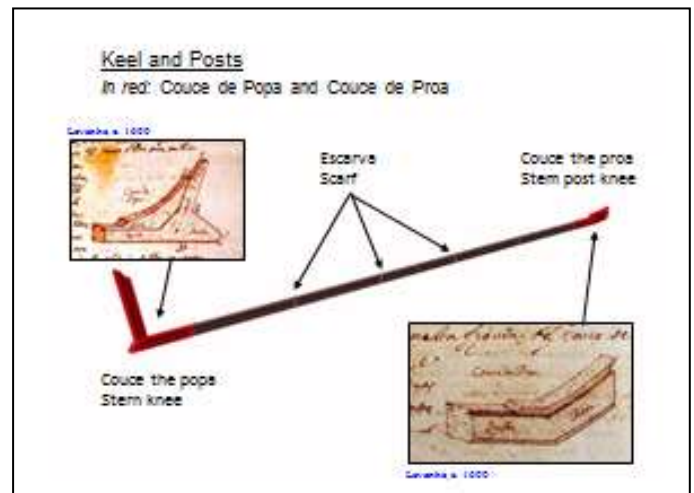
Although a lot has been published on the history of the Portuguese and Spanish seafaring, many ques-



Structural model by Halex Hazlett, based on the *Livro náutico* exhaustive list of the timebers necessary to build an Indiaman (2006).

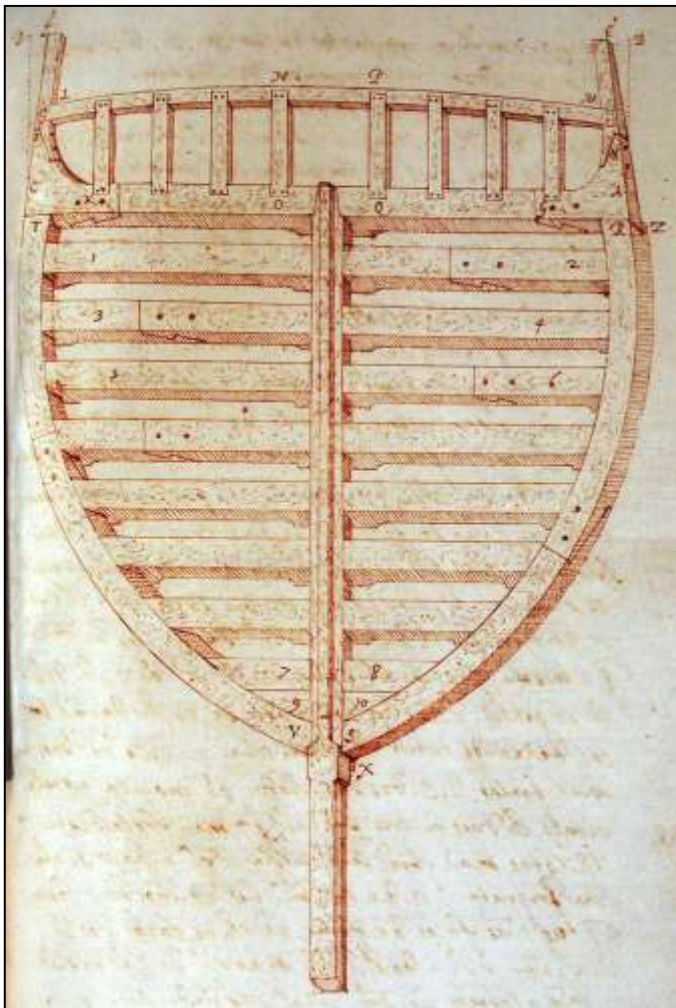


Ships were inhabited machines. The appropriation of their interior spaces is a very interesting subject, together with the delimitation and designations of the generated spaces.
Audrey Wells model, 2008.



Working drawing for the glossary project (Filipe Castro).

tions remain unanswered, for instance pertaining to the appropriation of the interior spaces and the redistribution of weights as the crews drunk the liquids and the ships got lighter. We expect that the



Stren panel structure for an Indiaman after João Baptista Lavanha, around 1600.

“Ship in Parts” project will help us gather a better understanding of the ship as a machine, a container, and an inhabited space.

With philologist Dr. Denise Gomes Dias, we are also looking at the genealogy of a number of words in use in Bahia, Brazil, in the context of the Saveiros Project.

Papers delivered at International Meetings

Gomes-Dias, D. And Castro, F., *Glossário ilustrado da carpintaria naval na Baía de Todos os Santos*. III Congresso Internacional de Dialectologia e Sociolinguística. Universidade Estadual de Londrina, Paraná, Brasil, October 7-10, 2014.

PROJECTS

Iberian Shipwreck Scantlings

1998 - present

P.I.: Filipe Castro

Questions pertaining to the size and strength of ship hulls have been discussed by shipwrights, sea captains, and politicians since long. The weight and speed of a ship are determinant factors for the success of both commerce and war, and although politicians have implemented these two adventures with the ships they had, as opposed to the ships they wanted, serious discussions have been recorded on the size, strength, speed, and seakeeping of vessels throughout history. Experiments and ideas have been tried and discussed, and at the ShipLAB we are interested in this aspect of the history of shipbuilding.

Naval strategy and shipbuilding have been connected for millennia, and the size and shape of merchant vessels inspired many controversies and political decisions.

Trees have been, however, a generally scarce and often expensive resource for shipbuilding and the navies that were built were not always the ones politicians desired. This is especially true for the Mediterranean world, where the depletion of forests is a well-known phenomenon.

Charcoal, house building, farming, and climate factors impacted the size and health of forests, and shipbuilding was a particularly interesting industry because it required the systematic harvest of particular types of trees. We do not know what impact this intensive selection and harvest of particular shapes had on the late medieval and early modern forests, but the subject is of particular interest for the history of seafaring.

We are interested in the study of the tree types and

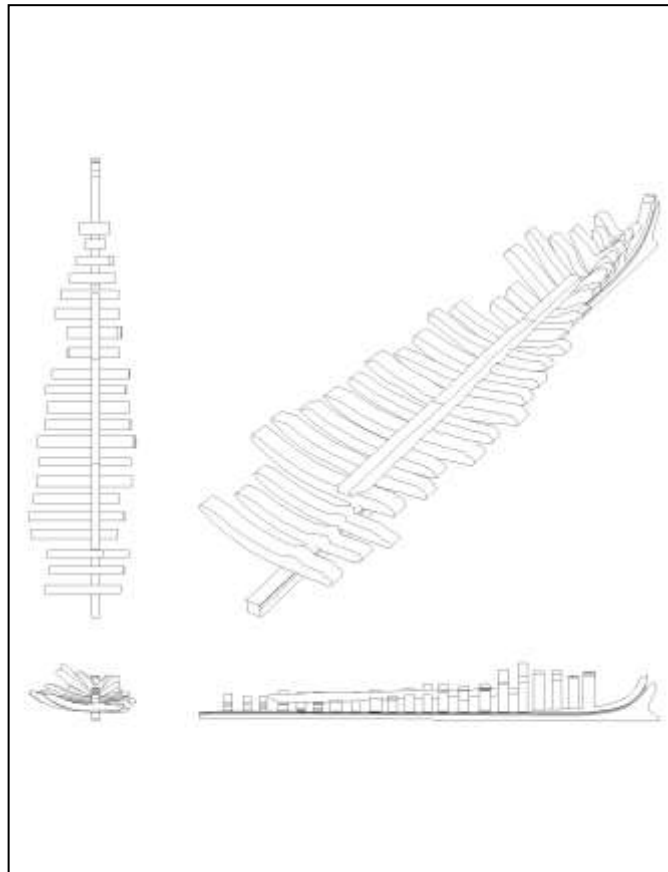
scantlings that went into the construction of particular ships at particular periods and geographical locations, the comparative advantages, and the consequences of the diverse distribution of resources.

Perception, taste, and the transfer of knowledge are equally interesting subjects, but without a solid database of facts and shipbuilding examples, all speculations are futile.

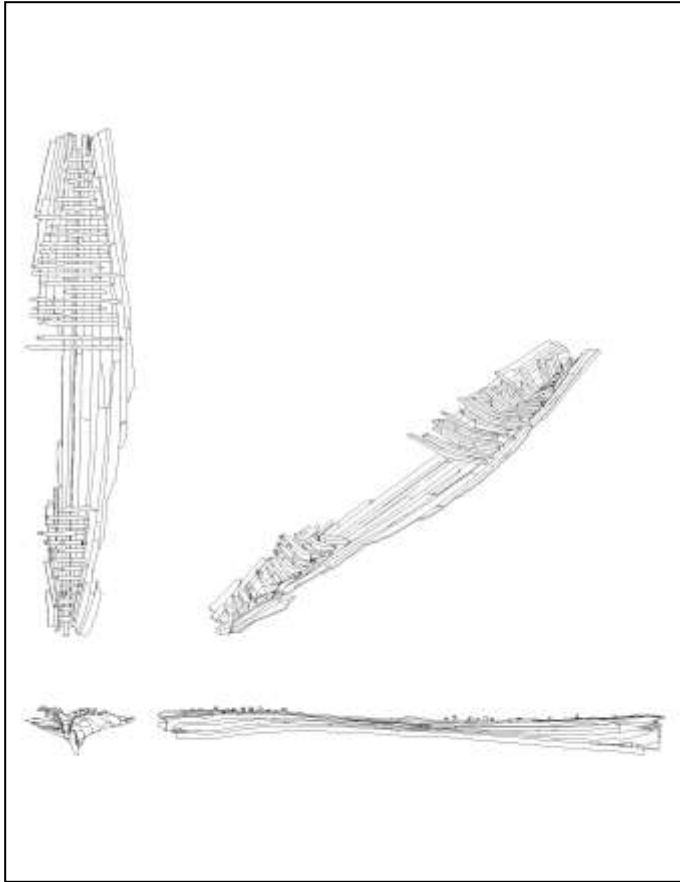
At the ShipLAB we are interested in studying the relations between the size and shape of ships and their scantlings, fastening patterns and scarfing patterns.

The reconstruction of a ship from scarce remains is always hypothetical and must always be taken as a tentative, educated guess. The study of the relations between scantlings and ship dimensions in several

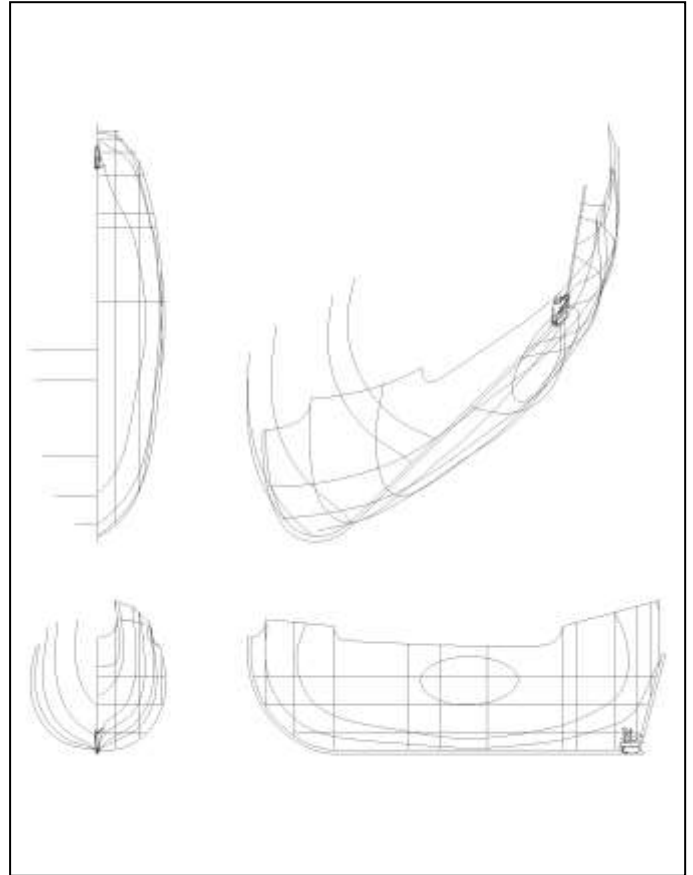
regions and periods may provide interesting insights and unveil general patterns that will help refine virtual reconstructions from scarce ship re-



Ria de Aveiro A shipwreck, c. 1450 (Thomas Derryberry).



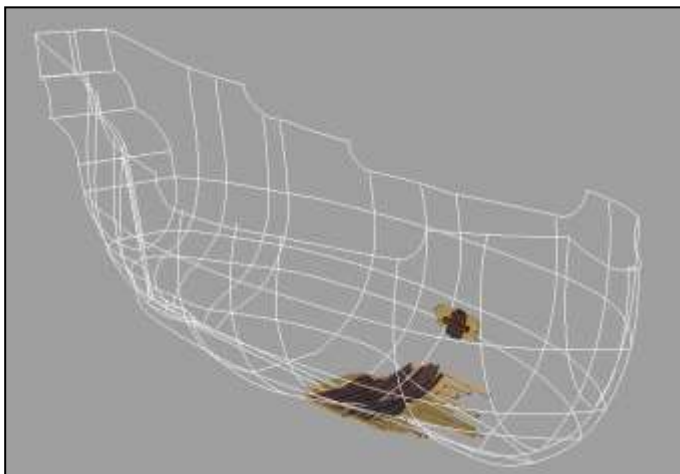
Cais do Sodré shipwreck, c. 1500 (Thomas Derryberry).



Corpo Santo remains (c. 1400) and hipotetical size of the original ship, according to Thomas Derryberry estimation (Thomas Derryberry).

mains.

Most Iberian shipwrecks have been destroyed by treasure hunters searching for artifacts with market value. Most Iberian hull remains have been savaged and abandoned to the elements without being recorded and in some instances - the best case sce-



Hypothetical reconstruction of the Pepper Werck with the hull remains represented, and published hull remains of the Oran-jemund shipwreck scaled up to fit the Pepper Wreck hypothetical size (Kevin Gnadinger and Filipe Castro).

nario - we are left with a small number of pictures that may sometimes allow the archaeologists to identify a detail here and there.

Scantlings can sometimes be estimated from pictures and the development of computer graphics promises to make the analysis of old pictures a relevant tool for archaeologists. At the ShipLAB we are trying to collect information from ships destroyed by treasure hunters in the hope that they one day may be useful for the study of the technological development of the 16th century.

Publications

Castro, F., "Tonnages and displacements in the 16th century" in *Journal of Archaeological Science* (2013) 40: 1136-1143.

Castro, F., "A Group for the Study of Iberian Seafaring," in Castro, F. and Custer, K., eds., *Edge of Empire. Proceedings of the Symposium held at the 2006 Society for Historical Archaeology Annual Meeting, Sacramento, California*, Lisbon: Caleidoscópio, 2008.

PROJECTS

Iberian Shipwrecks Database

1998 - present

P.I.: Filipe Castro and Alexandre Monteiro

At the ShipLab we are collecting data on Iberian shipwrecks and building a database with basic information, bibliography, iconography and publications.

It is often difficult to establish dimensional relations between basic ship parts, their registered tonnage, and the sections of their structural timbers.

We are interested in the variations around the relations between a ship's basic dimensions, the size of its crew, its cargo capacity, routes, and the trends observed all over Europe, while varying from place to place and through time.

Ships are single artifacts produced by different maritime landscapes depending on the access to the necessary materials, taste, money, and technology available, but always in a cosmopolitan background, in which ideas travelled, adapted and evolved, crystallized, or died.

Ole Crumlin-Pedersen and Eric Rieth remind us that some construction particularities are local and

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Portion of our shipwreck spreadsheet, which presently has around 80 columns and over 200 shipwrecks.

PROJECTS

Architectural Signatures

2006 - present

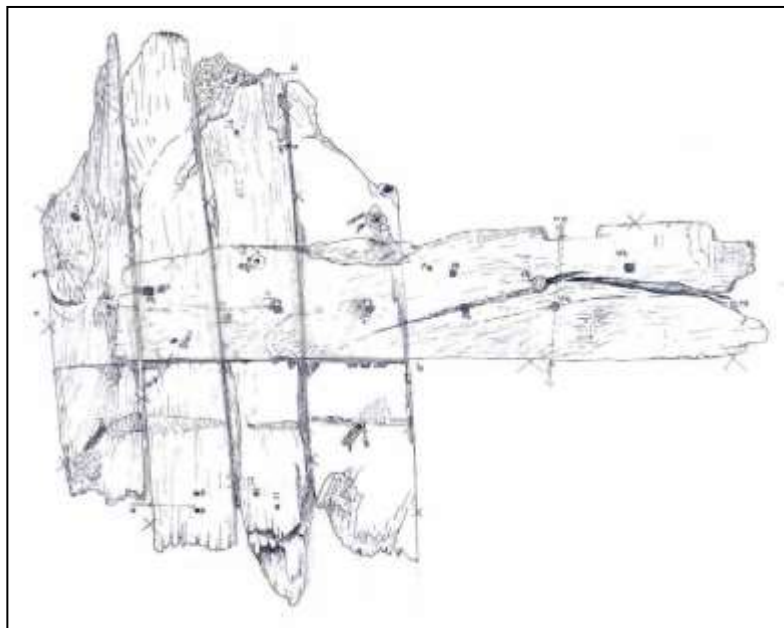
P.I.: Filipe Castro

Shipwrights built ships following traditions and procedures that are hard to reconstruct. These are interesting because they encompass practices both learned and developed, and perceptions and convictions which are intimately related to the environments where they learned their business. Typical anthropological questions pertaining to where knowledge resides and how it is disseminated are always interesting to investigate, and ships carry in their hulls marks of practices and processes that allow archaeologists to connect with regions and timeframes. Ole Crumlin-Pedersen and Eric Rieth called them architectural signatures. We are interested in the traits that are typical to the Iberian Peninsula in the early modern period.

It is very difficult to establish differences in shipbuilding traditions at any given time. The historical and archaeological records are scarce, history and archaeology are tremendously parochial as scientific disciplines and still informed by 19th century nationalistic myths, and ships operated in the most progressive and cosmopolitan environment of each era or period.

Function, taste, knowledge, economic factors, accessibility of building materials and political climates, all greatly influenced the size and shape of ships. There is evidence that the adoption of shipbuilding gestures and traits was quick and

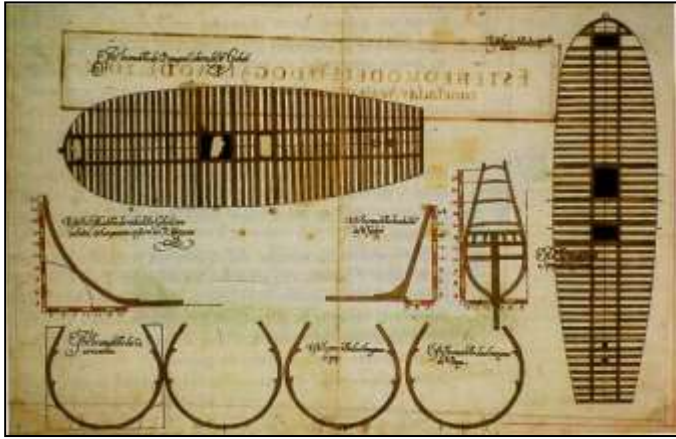
easy, although the shipbuilding world was largely illiterate until the late 16th century.



Frames and clamp from the Orjemund shipwreck showing the “dentes” referred to in the technical literature and never before observed in the archaeological record (Miguel Aleluai and Francisco Alves).

The study of architectural signatures was proposed by several authors. Perhaps best known works on this subject are those of Ole Crumlin-Pedersen and Eric Rieth, who identified cultural traits - memes - that are characteristic to certain areas and periods, and whose development and sometimes spread can be traced in the archaeological record.

Thomas Oertling published the first studies pertaining to the basic characteristics of Iberian ships in the 1980s and 1990s. His seminal work generated a number of theoretical discussions



Manoel Fernandez treatise on shipbuilding dating to 1616 and showing the “dentes” on the inner surface of each frame, at the level of the clamps (Ms. Livro de Traças de Carpintaria, 1616, Biblioteca da Ajuda).

around the origin and characteristics of oceangoing Iberian ships.

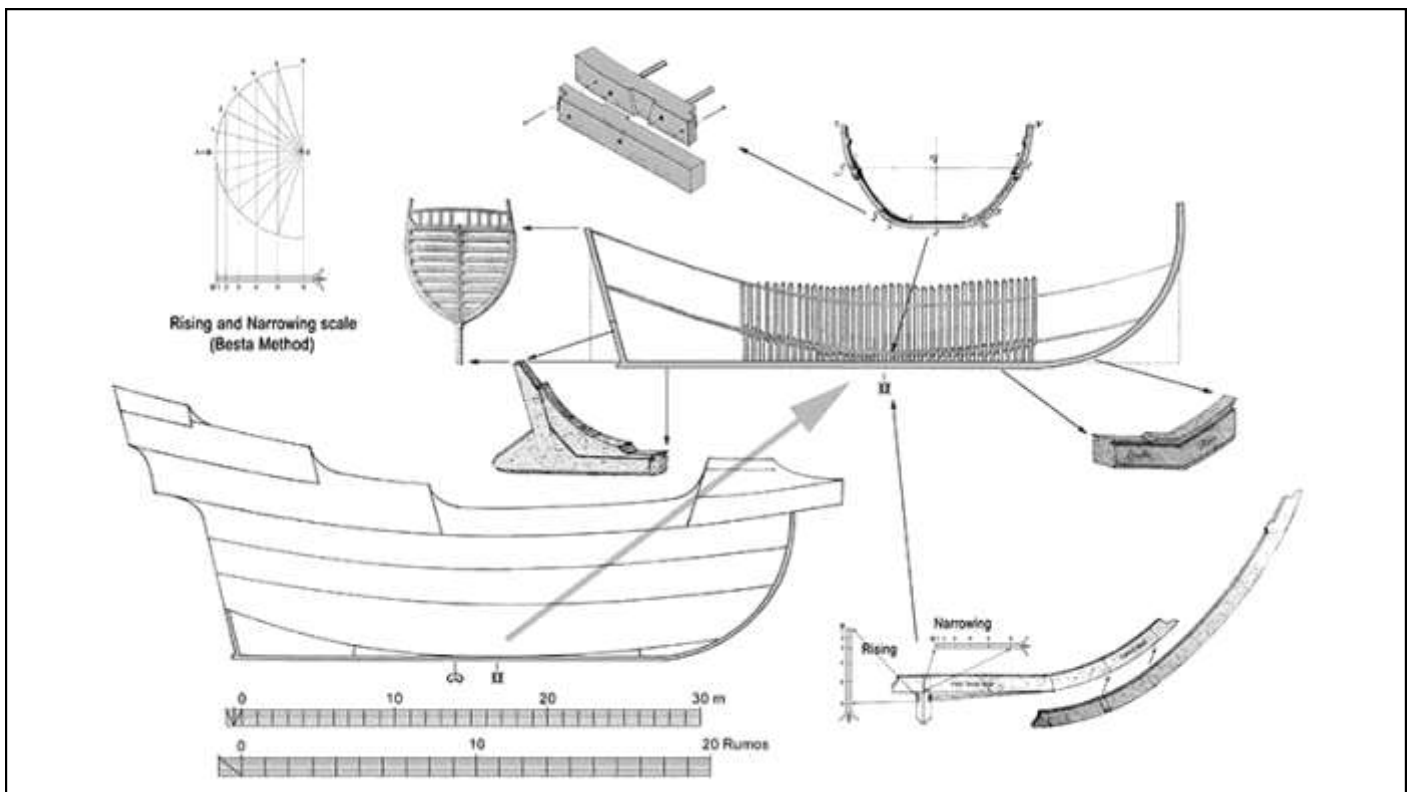
In the last decades, however, some of the traits believed to be Iberian were found in shipwrecks built in Northern European shipyards for the Atlantic and Baltic trade. Identifying shipbuilding characteristics that may be typical in a region and period is an important step to understand the flow of technological information in the early modern period and one of the outcomes of the ForSEAdiscovery Project.

At the ShipLAB we are working to select and study potential Iberian shipbuilding memes, and trying to understand the story of each one, its appearance and trajectory.

The cultural transmission process in early modern Europe is an important component of the ForSEAdiscovery Project.

Publications

Castro, F., “The Concept of Iberian Ship,” *Historical Archaeology* (2008) 42.2: 63-87.



Iberian ships have some particular characteristics that seem to be regional, appearing in the Atlantic and perhaps spilling into the Baltic Sea as well (Filipe Castro).

PROJECTS

Ship Iconography Database

2007 - present

P.I.: Filipe Castro

Images of ships and maritime scenes are invaluable to the understanding of past seafaring life. The ShipLAB has a database of ship images organized by date and provenience, and is presently trying to develop taxonomies and relate the ship types mentioned in documents with the images represented.

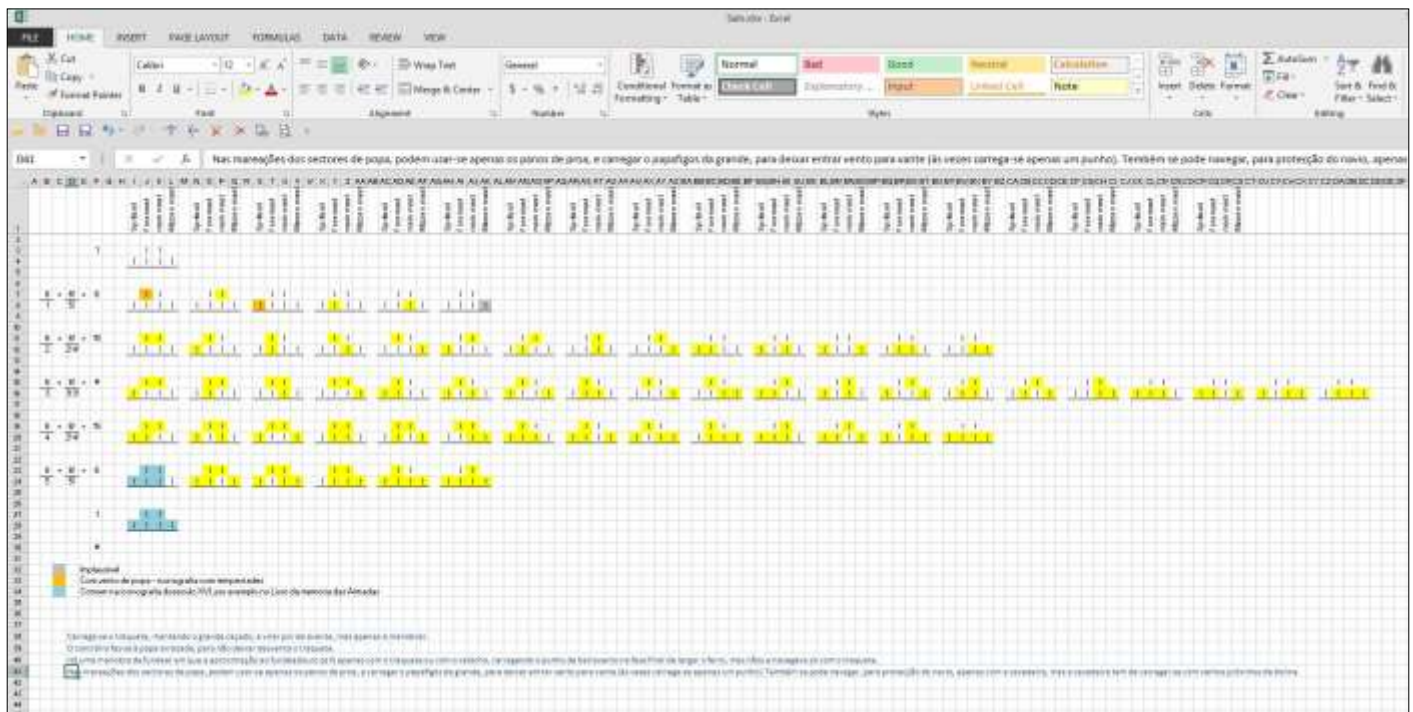
Iconography is a good source of information about the past, providing that we keep in mind that throughout history most artists tend to base their painting on other artists representations of reality, rather than use nature and reality as a model.

During the late 15th and early 16th centuries a number of voyages of discovery were launched from the Iberian Peninsula and other regions of western Europe, and these voyages demanded increasingly larger and better ships. It was not until the late 16th century that ships started to appear as the main subject of paintings. Before that period,

most good representations of ships appear in maps, which presented large unknown surfaces to the map makers, and for that reason tended to be illustrated, both on land and on the sea.

It is known that in the 15th century, when painters were not working, map makers could be a fair source of income.

The study of ships and seafaring in this period is greatly enriched with the study of a meaningful sample of the coeval iconography, and the ShipLAB has a collection of about 5,000 images,



Matrix with the possible rigging configurations (Filipe Castro).

ID	Century	Date	Title
1	16	1509	Livro das Fortalezas
Support	Work Title	Work - Folio or Page	
Parchment	Livro das Fortalezas	5	
Work - Specific Details		Author	Country of Origin
Mértola		Duarte d'Armas	Portugal
		Portugal	Country of Ob. Represented
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Ship Type	Decks	Image	
Type 13 - c	1	<input checked="" type="checkbox"/> Transom	
<input checked="" type="checkbox"/> Toldo <input type="checkbox"/> Alicaporta <input type="checkbox"/> Capitulo <input type="checkbox"/> Guarita <input type="checkbox"/> Sobreguarita			
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Sailing <input type="checkbox"/> Rowed <input type="checkbox"/>			
Maneuvering <input type="checkbox"/>			
Comments:			
Type 13 - Three-masted lateener (caravela?). At anchor. Sails furled.			

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<input type="checkbox"/> Bowsprit	<input type="checkbox"/> Foremast	<input checked="" type="checkbox"/> Mainmast	<input checked="" type="checkbox"/> Mizzenmast
Yards	<input type="checkbox"/> Fore Topg. Yard	<input type="checkbox"/> Main Topg. Yard	<input type="checkbox"/> Bonaventure Toomast
<input type="checkbox"/> B. Topsail Yard	<input type="checkbox"/> Fore Topsail Yard	<input type="checkbox"/> Main Tops. Y.	<input type="checkbox"/> Mizzen Tops. Y.
<input type="checkbox"/> Sprit Yard	<input type="checkbox"/> Foreyard	<input type="checkbox"/> Mainyard	<input type="checkbox"/> Mizzen Yard
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which must be systematically studied and classified according to their quality, date, and provenience.

The use of stock images in this period seems to have been common, and makes the interpretation of images difficult because the art market has al-

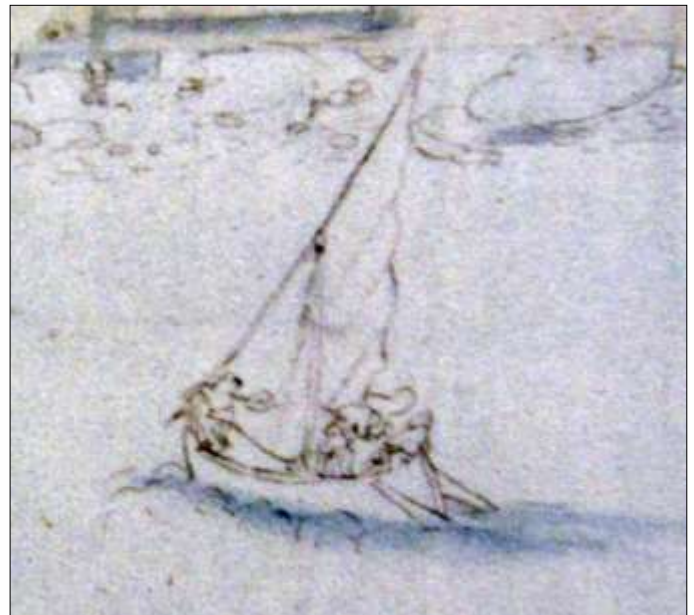
ways been an international market and images travelled extensively, and kept travelling since then.

In this context, the ShipLAB is developing a series of morphological matrixes, timelines, and Google Maps, in order to sort and organize each image.

Models have been added to this collection recently, although we are still in the process of selecting the support software in which we plan to organize them.

An important research question is that of the names of ship and boat types through time. It is often impossible to describe certain typologies that appear in historical documents, and no attempts have been made - to our knowledge - to develop a comprehensive typology based on the morphological characteristics of boats and ships represented in the existing iconography.

Following procedures well tested in biology, the ShipLAB is developing a morphological matrix that will hopefully help characterize a considerable number of ship types from written texts and establish connections - although with different levels of certainty - between names, descriptions, and iconographical representations of ships and boats through time and in the geographical spaces considered.



PROJECTS

Astrolabes Database

2005 - present

P.I.s: Filipe Castro and James Jobling

The ShipLAB is collecting information on nautical astrolabes in collaboration with Alan Stimson and as of May 2013 we have an inventory of 99 nautical astrolabes.

Introduction

Nobody knows when astrolabes were invented. They appear in Hellenistic times and their development is sometimes attributed to Greek or Egyptian astronomers. In Antiquity astrolabes were mainly used by astronomers and astrologers, but in the late Medieval and early Modern Period a simplified version appears, in the Iberian Peninsula, used by navigators to calculate Latitudes based on the height of the Sun at Noon, for which sailors had especialy calculated tables.

Astrolabes were made of wood or brass, and few have survived to our days, all in brass.

Because they have a high market value for collectors, many have been looted from archaeological sites, and their proveniences are sometimes kept secret by the looters, with the full cooperation of the most important international auction companies.

As it often happen with artifacts with high demand in the antiques' markets, there is a number of fakes in circulation, and it is often difficult to assert the quality and autenticity of an astrolabe in the jungle of crooks and liars that deals in antiques worldwide.

Scholarly interest in astrolabes is old and the first published inventory of the known nautical astrolabes dates to 1957, when David Waters published the then 10 astrolabes known.

Other inventories were published after 1957, and the most recent comprehensive one was published in 1988 by Alan Stimson, then the Curator of Astronomy and Navigation at the National Maritime Museum in Greenwich, containing atotal of 65 astrolabes. Stimson's list attributed a registry number to each astrolabe starting with NMM (National Maritime Museum number).

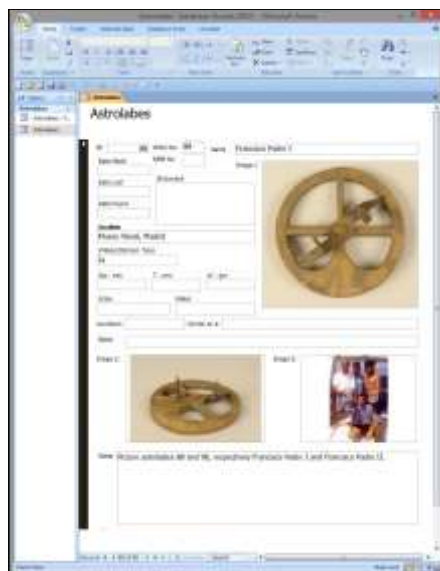
In 2005 Gustavo Garcia published an additional list with 16 additional astrolabes, using, when possible, the NMM numbers. This was difficult, however, because the NMM list is not public.

After Gustavo's work was published as an MA Thesis at Texas A&M, the ShipLAB started collecting information about existing astrolabes, and James Jobling joined the project, contacted Mr. Stimson, and got access to the NMM list, which allowed the ShipLAB to coordinate the numbering with Mr. Stimson.

Our inventory presently has 102 astrolabes, although we did not have access to all of them and cannot possibly autenticate them all as real.

A number of fakes have surfaced as well, as the antiquities markets soar and demand does not stop to grow.

The publication of an updated list is important because it will allow scholars and collectors to at



Astrolabe database: we are still gathering data on many of the specimens located on the internet and in auction catalogues (Filipe Castro).



Francisco Padre II astrolabe, found in the 1980s in Cuba and signed Sebastião de Gois.



Fake astrolabe offered by Christie's in 2013. In the catalogue the seller claims that it was in a private collection since the 1920s.

least have an idea of the number of specimens known to have been found, and perhaps avoid the sale of fakes.

Graduate Work

Gustavo Garcia, *The Rincón Astrolabe Shipwreck* (MA 2000-2005).

Publications

Garcia, G., "Nautical astrolabes," in Castro, C. and Custer, K., eds., *Edge of Empire. Proceedings of the Symposium held at the 2006 Society for Historical Archaeology Annual Meeting, Sacramento, California*, Lisbon: Ed. Caleidoscópio, 2008, 249-274.



Three astrolabes found at São Julião da Barra. Portugal, near Lisbon, presumably all from the shipwreck of the Portuguese Indian *Nossa Senhora dos Mártires*, lost in 1616.

PROJECTS

Iberian Shipbuilding Texts

2001 - present

P.I.: F. Castro and A. Monteiro

The Nautical Archaeology Program at Texas A&M University is perhaps the only graduate program in maritime archaeology that teaches one course exclusively on books and treatises on shipbuilding. Over the years, the ShipLAB has gathered an important collection of texts on shipbuilding and has been working with other scholars to transcribe and study the most important.

Although almost nothing is known about ship conception and construction in Portugal and Spain in the late medieval period and up until the late 16th century, after 1570 there is an important collection of manuscripts with technical texts pertaining to the construction and operation of ships in the late 16th and early 17th century. The quality of the texts varies and the content is sometimes vague and difficult to understand.

Most times these treatises were not written by shipwrights, and in certain cases the surviving texts are copies of lost originals. Sometimes mistakes were made by the copyists, sometimes entire lines of the original texts were overlooked, and often the texts are diffi-

cult to interpret and lack data that would allow the reconstruction of the ships described.

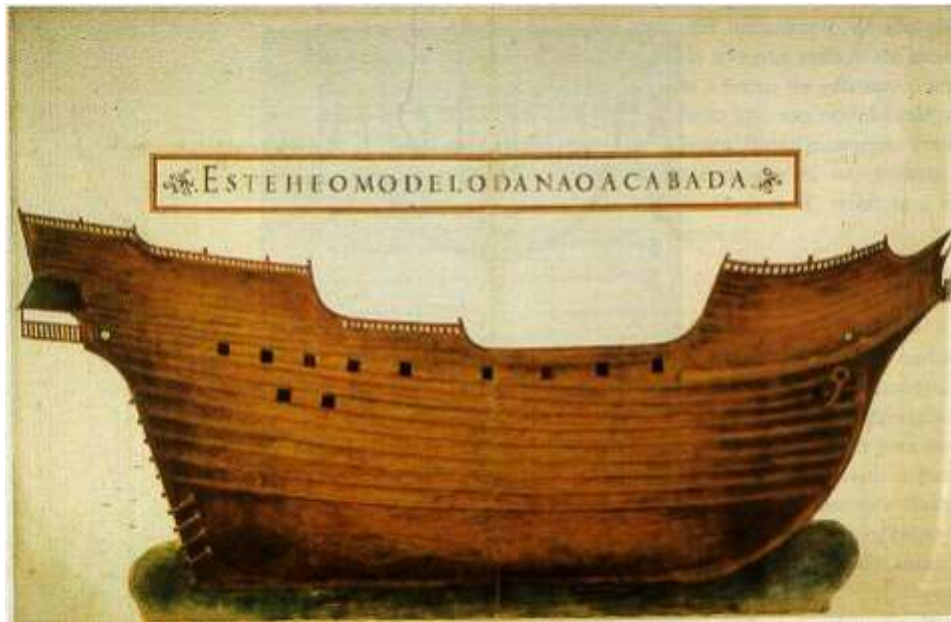
The study of these treatises is therefore complex and requires time and simulation methods that may

allow the researchers to iterate the solutions until more plausible results are achieved.

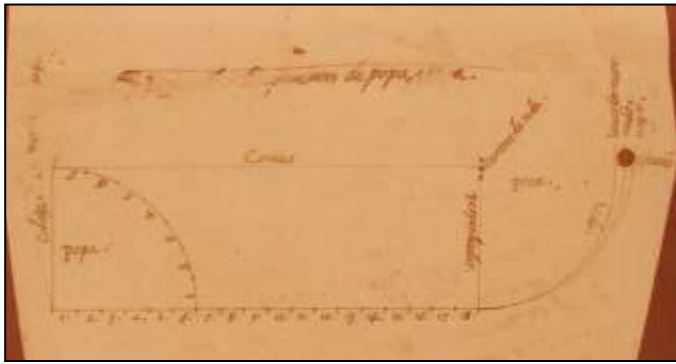
A comparative study of the most important texts has never been published, and the Ship-LAB team is working on a small group, both Portuguese and Spanish, and hopes to at

least fix some texts and make them available for study by a wider team of scholars.

The importance of the theoretical - scholarly -

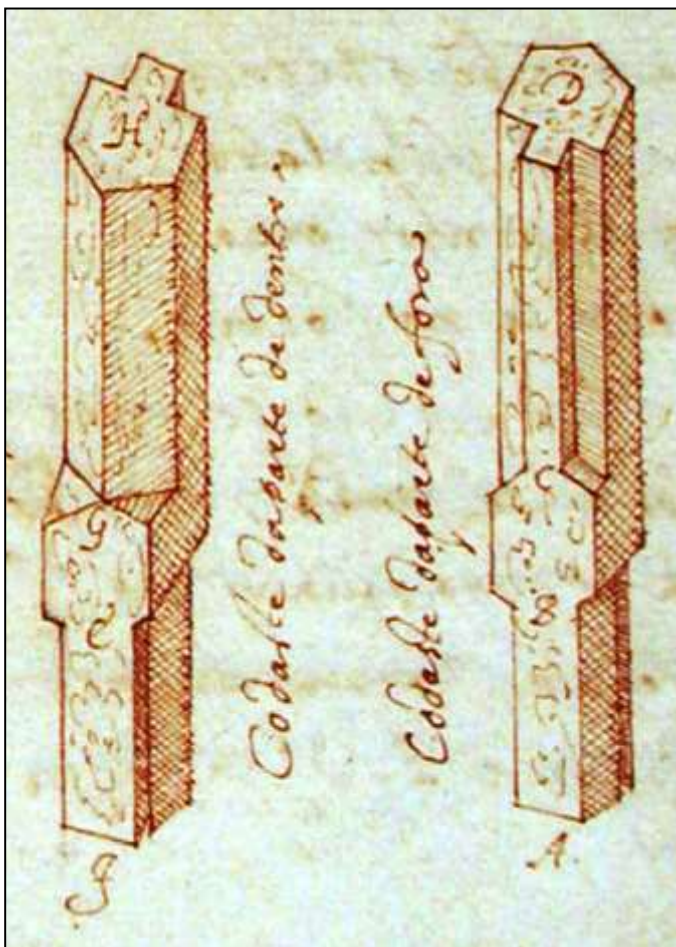


Nao of 600 tons in the 1616 *Livro de Traças de Carpintaria*, a manuscript signed by an unknown Manoel Fernandez, which contains a collection of recipes to build both long and round ships (Biblioteca da Ajuda).

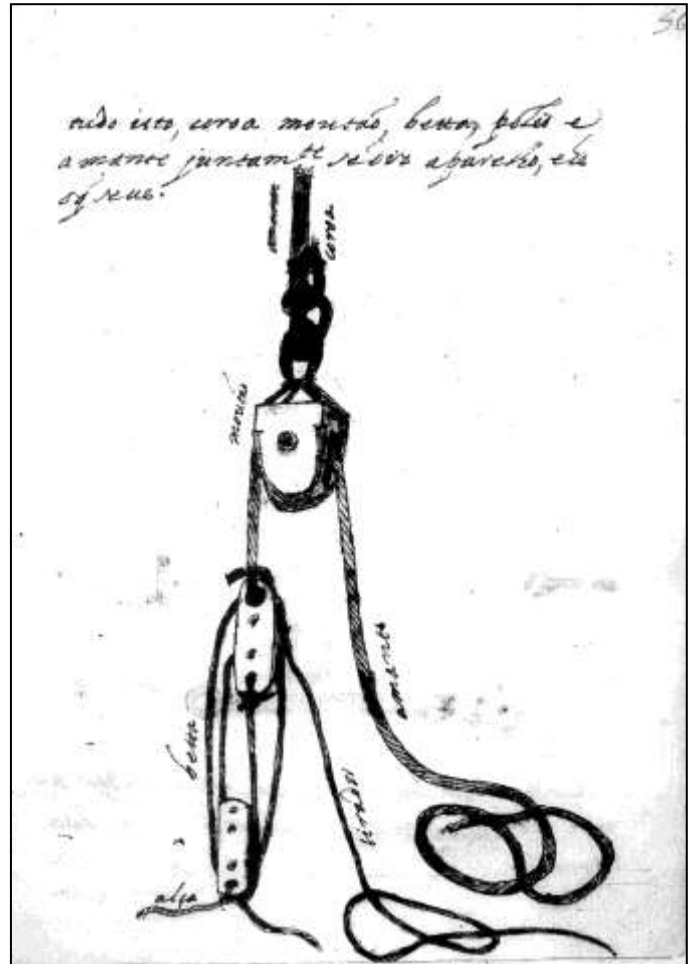


Rules for tracing the stem and sternposts for a 600 tons nao around 1580, in a text by Fernando Oliveira (*Livro da fábrica ds naos*, manuscript in Lisbon's National Library).

component in the history of Iberian shipbuilding is often overlooked when the history of the Iberian expansion is described and we are working to bring this subject to light. Portuguese and Spanish ships sailed the longest routes in the 16th century and Iberian shipwrights deserve credit for their design



João Baptista Lavanha's details for the shape of a sternpost around 1600 (*Livro Primeiro de Architectura Naval*, manuscript in the Library of La Real Academia de la Historia, Madrid, Spain).



Page from *Advertencia de Navegantes*, by Captain Marcos Cerveira de Aguiar, dated to circa 1641 (Lisbon's National Library).

and improvement.

This project is complemented by the “Ship in Parts” project and will complement the multidisciplinary work of the ForSEAdiscovery team.

PROJECTS

Cape Finisterre Project, Spain

2011 - present

P.I.: Miguel San Claudio

Since 2011 the ShipLAB is cooperating with Spanish archaeologist Miguel San Claudio in several projects in Galicia, aiming at inventorying, studying and publishing the region's impressive underwater cultural heritage. We are also collaborating on several research topics related to the Spanish maritime world of the 16th and 17th centuries, when Spain built and sailed some of the best ships in the world.

Cape Finisterre extends from the Iberian mainland into the North Atlantic and lies along one of the most important maritime routes in the region. With its rocky coastline and reefs, brutal winter storms, dangerous currents, and dense fogs this dangerous coastline is known in Spain as *La Costa de la Muerte* (Coast of Death) and has become the final resting place for many ships, along with their passengers and crew.

One of the worst maritime disasters to occur in this area took place on the night of October 28, 1596, when a storm took an armed Spanish fleet by surprise off Cape Finisterre.

In the last decades of the 20th century the remains of what seemed to be one of the 1596 shipwrecks were discovered by seafood harvesters at Punta Restelos. In 2007, looting of this shipwreck was detected and communicated to the authorities. The Regional Government of Galicia supported a preliminary archaeological survey of the Punta Restelos shipwreck to document the archaeological remains. The survey was conducted by the Spanish archaeologist Miguel San Claudio and his Cultural Resource Management (CRM) firm Archeonauta S.L. During the surveys, six more shipwrecks,

which are thought to be part of the fleet of 1596, were located together with shipwrecks from later periods.



Aspect of the Punta Restelos shipwreck (Miguel San Claudio).

Our collaboration with Miguel San Claudio entails also the survey and sampling of a number of Galician shipwrecks in the context of the ProSEAdiscovery grant, as well as the development of the database of Iberian shipwrecks, and the database of early modern ship iconography.

Communications at International Meetings

San Claudio, M., Castro F., Gonzalez, R., Casabán, J.L. El pecio de Ribadeo, un excepcionalmente bien conservado pecio español del siglo XVI. I Congreso de Arqueología Náutica y Subacuática Española. ARQVA – Museo Nacional de Arqueología Subacuática. Cartagena (España). Marzo 2013.

Casabán, J.L., San Claudio, M., Castro F., Gonzalez, R. Pecio de Punta Restelos. I Congreso de



Sixteenth century helmet from one of the Galician shipwrecks (Miguel San Claudio).

Arqueología Náutica y Subacuática Española. ARQVA – Museo Nacional de Arqueología Subacuática (España). Marzo 2013.

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Casaban, J., San Claudio, M., Gonzalez, R. and Castro, F., “El Pecio de Punta Restelos. Un buque de Armada de 1596”, Prieto, J., Pernía, A., and Sanchez, P., eds., *Actas del I Congreso de Arqueología Náutica y Subacuática Española*, Madrid: Ministerio de Educación, Cultura y Deporte, 2014, 233-243.

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Pewter porringer from the 1596 Punta Restelos shipwreck (Miguel San Claudio).

PROJECTS

Pepper Wreck Portugal

1998 - present

The Pepper Wreck - presumed to be the Portuguese Indiaman Nossa Senhora dos Mártires, lost in 1606 - was found on the Tagus River mouth, Lisbon, Portugal, in 1993, during an archaeological survey promoted by the Museu Nacional de Arqueologia, directed by Francisco Alves. From 1996 to 1998 it was excavated by the Instituto Português de Arqueologia / Centro Nacional de Arqueologia Náutica e Subaquática, as part of the program of the Portuguese pavilion at the 1998 world exhibition EXPO'98. In 1999 and 2000 the remains of its hull were excavated by the Centro Nacional de Arqueologia Náutica e Subaquática, with the support of the Institute of Nautical Archaeology / Texas A&M University. The study of its hull remains - which include a portion of the keel, eleven frames, and some of the planking - in cooperation with the Centre for Marine Technology and Engineering from Instituto Superior Técnico, yielded interesting results and a first glance at the largely unknown Portuguese naus da Índia.

Books

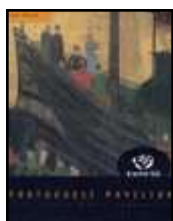


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Afonso, S., ed., *Nossa Senhora dos Mártires: A última viagem*. Lisboa: Verbo / EXPO'98, 1998.

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Lenihan, Dan, "Nautical Soundings" review of George Bass' *Beneath the Seven Seas*, in *Archaeology Magazine* (2006) 59.3.

Loewen, B., Review of my book *The Pepper Wreck*, in *International Journal of Nautical Archaeology* (2006) 35.1: 169-171.

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Remains of the hull exposed in 1996 (Francisco Alves).

Fontenoy, P., Review of *The Pepper Wreck*, in *Nautical Research Journal* (2005) 50: 122.

Special Lectures

Castro, F., *Computers and Shipwrecks: The Pepper Wreck Reconstruction as a Virtual Hypothesis*, Archaeological Institute of America J. Richard Steffy Lecture, Spokane Northwest Museum of Arts and Culture, Washington State, March 4, 2009.

Castro, F., *Computers and Shipwrecks: The Pepper Wreck Reconstruction as a Virtual Hypothesis*, Archaeological Institute of America George H. Forsyth, Jr. Lecture, University of Iowa, Iowa, October 6, 2008.

Castro, F., *Sailing a Portuguese Indiaman*. Archaeological Institute of America Danyale Z. English Lecture. Washington DC Society. February 2007.

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Castro, F., *The Pepper Wreck: Excavating and Reconstructing an Early 17th-Century Portuguese Indiaman*. Archaeological Institute of America McCann and Taggart Lecture Series in Underwater Archaeology. Western Illinois Society, Monmouth College. November 2005.

Castro, F., *The Pepper Wreck: Excavating, Reconstructing and Rigging an Early 17th-Century Portuguese Indiaman*. Archaeological Institute of America McCann and Taggart Lecture Series in Underwater Archaeology. Oberlin-Wooster Society, College of Wooster. November 2005.

Castro, F., *The Pepper Wreck: Excavating and Reconstructing an Early 17th-Century Portuguese Indiaman*. Archaeological Institute of America McCann and Taggart Lecture Series in Underwater Archaeology. Cleveland Society, Cleveland Museum of Natural History. November 2005.

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constructing an Early 17th-Century Portuguese Indiaman. Archaeological Institute of America McCann and Taggart Lecture Series in Underwater Archaeology. Kent-Akron Society, University of Akron. November 2005.

Castro, F., *The Pepper Wreck: Rigging a Portuguese Indiaman*. Archaeological Institute of America McCann and Taggart Lecture Series in Underwater Archaeology. Western Illinois Society, Monmouth College. November 2005.



Raising diagnostic timbers in 1999
(Guilherme Garcia).

Keynote Addresses and Invited Talks

Castro, F., *Arqueologia Subaquática e História da Náutica – A bordo de uma nau da Índia em 1600*, Faculdade de Letras da Universidade de Lisboa, April 16 2010.

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Castro, F., *Life Aboard a Portuguese India Nau*, Trinity University, San Antonio, TX. Invited by the Southwest Texas Archaeological Society and Trinity University. September

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Castro, F., *A reconstrução de uma nau da Índia do início do século XVII*. Segundo Curso de Verão: História da Náutica, Lagos, Portugal. June 2007.

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Castro, F., and N. Fonseca. *A bordo da nau de SJB2, 'The Pepper Wreck'* XIII Reunión Internacional de Historia de la Nautica y de la Hidrografia. Borja, Spain, November 2006.¹

Castro, F., and N. Fonseca. *Reconstrucción de una nao da la India de los inicios del siglo XVII*. Nossa Senhora dos Mártires, 1606?, IIs Jornadas de Universitárias de Arqueología Subacuática, Universidad de Huelva, Huelva, Spain. Invited by the University of Huelva. Paper delivered by Mr. Cláudio Lozano, 28 to 30 November 2005.

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Castro, F., *The Pepper Wreck*, Galveston Seaport Museum, November 1999.

Castro, F., *A 17th-Century Wreck at the Mouth of the Tagus River*. Shipwreck Weekend, Texas A&M University 1999.

Castro, F., *An East Indiaman off the Lisbon Sandbar* at Brown Bag Talks, Anthropology Department, Texas A&M University, 1998.

Castro, F., *The Pepper Wreck*, Invited Lecture in the course ANTH628 - New World Seafaring, Texas A&M University, 1998.

Castro, F., *The remains of a Portuguese Indiaman at Tagus mouth, Lisbon, Portugal (Nossa Senhora dos Mártires, 1606?)*, International Symposium 'Archaeology of Medieval and Modern Ships of Iberian-Atlantic Tradition', Lisbon, 1998.

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Fonseca, N., Santos, T., Castro F., "Study of the Intact Stability of a Portuguese Nau from the Early XVII Century," in G. Soares, Garbatov & Fonseca, eds., *Proceedings of the IMAM 2005 Conference: Maritime Transportation and Exploitation of Ocean and Coastal Resources*. London: Taylor and Francis Group, 2005: 841-849.

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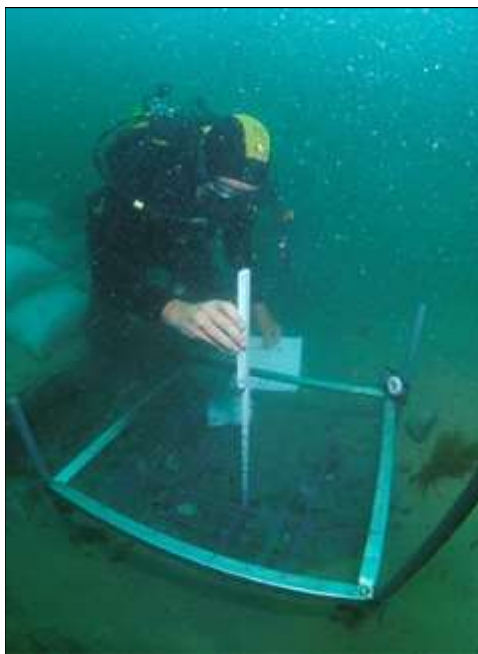
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Recording remains of the caulking arrangement underneath a portion of the hull removed (Guilherme Garcia).

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Castro, F., N. Fonseca and T. Santos. *Rigging an Early 17th Century Portuguese Indiaman*, 38th Society for Historical Archaeology Annual Conference, Sacramento, CA, January 2006.

Castro, F., *O aparelho de uma nau da Índia: a origem do navio de três mastros*, 4.º Congresso de Arqueologia Peninsular, Faro, Portugal, 2004.

Castro, F., *Os destroços de uma nau da Índia na foz do Tejo, Lisboa, Portugal*, 3.º Congresso de Arqueologia Peninsular, Porto, 1999.



Raising a portion of the keel (Guilherme Garcia, 1999).



Lisbon's Naval Museum has a window dedicated to the Pepper Wreck.

Reports

Vacas, T., *Reconstrução Virtual da Nau Nossa Senhora dos Mártires*. Instituto Superior Técnico. On file in Nautical Archaeological Program Library, Texas A&M University, 2002.

2007.

Sabrosa, A., *De Macau a Lisboa – Na Rota das Porcelanas Ming*. Lisbon: Instituto Cultural da REAM, 2004.

Brigadier and Randolph, *SJB2 Artifact Catalog – ShipLab Report 1*. On file in Nautical Archaeological Program Library, Texas A&M University, 2002.

Castro, F., *The Pepper Wreck Timbers – ShipLab Report 1*. On file in Nautical Archaeological Program Library, Texas A&M University, 2002.

Castro, F., *São Julião da Barra Archaeological Complex – ShipLab Report 7*. On file in IPA/CNANS' library, 2002, and in Nautical Archaeological Program Library, Texas A&M University, 2002.

Castro, F., *SJB2 - Analysis of the Futtocks*, on file in IPA/CNANS' library, 2000.

Castro, F., *Pewter Plates from São Julião da Barra*, on file in IPA/CNANS' library, 2000.

Castro, F., *SJB2: Relatório dos trabalhos realizados em 2000*, on file in IPA/CNANS' library, 2000.

Castro, F., *SJB2: Relatório dos trabalhos realizados em 1999*, on file in IPA/CNANS' library, 1999.

Graduate Work

Sara Brigadier. *The Artifact Assemblage From the Pepper Wreck: An Early Seventeenth Century Portuguese East-Indiaman That Wrecked in the Tagus River* (MA 1998-2002 – Chair: Kevin Crisman).

Inês Coelho. *A cerâmica oriental da carreira da Índia no contexto da carga de uma nau – a presumível Nossa Senhora dos Mártires*. Lisbon: Master Thesis, Universidade Nova de Lisboa, 2008.

Newsletter Articles and Popular Publications

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Castro, F., "Reconstrução de uma nau da Índia: a presumível *Nossa Senhora dos Mártires* (1606)" *VEGA* (November / December 2005) 17: 22-28.

Castro, F., "Depois dos mergulhos II. *Nossa Senhora dos Mártires*, 1606" *Mundo Submerso* (2004) 7.86: 68-71.

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Brigadier, S., "Artifacts from São Julião da Barra", *INA Quarterly*, (Winter 2000), 27.4: 10-12

Castro, F., "The last field season on the Pepper wreck. A preliminary analysis of the hull", *INA Quarterly*, (2000) 27.4: 3-9.

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In the Media

This project was extensively covered in the media because it was the theme of the Portuguese Pavillion in the World Exhibition EXPO'98, held in Lisbon in 1998 and 1999, as well as the first project carried out by the then newly created Centro Nacional de Arqueologia Náutica e Subaquática, the state agency for nautical archaeology created in 1997.



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Tesouros no fundo do mar português. 2.º e 3.º Ciclos do Ensino Básico. Lisbon: Grupo de Trabalho do Ministério da Educação para as Comemorações dos Descobrimentos Portugueses, 1998 .



Julia Bruce and Peter Dennis, *Sail!: Can You Command a Sea Voyage?* Berkeley Heights, N.J. : Enslow Elementary, 2009



Preparing to dive in the winter of 1996 (Augusto Salgado)

PROJECTS

Sailing the Pepper Wreck

2006-2014

Centre for Marine Technology and Engineering (CMTE), Instituto Superior Técnico.

This study was a collaborative project between the disciplines of nautical archaeology and naval engineering, and consists of a series of tests with the model of the 1606 Portuguese vessel Nossa Senhora dos Mártires, also known as the Pepper Wreck, developed in the ShipLAB between 2001 and 2006.

Introduction

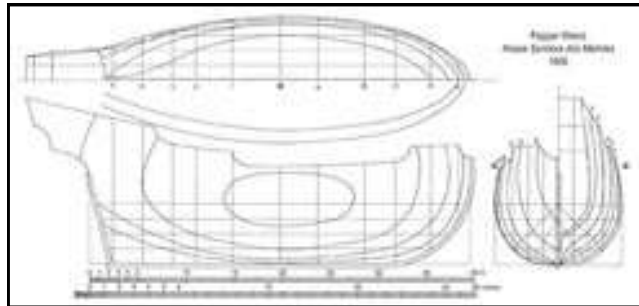
Based on the information retrieved from the Pepper Wreck's archaeological remains, compounded with almost a century of studies on iconography and contemporary written sources, both literary and technical, the main objectives of this project were:

- a) To obtain a plausible configuration for the hull, masts, spars, rigging and sail plan of an India *nau*;
- b) To try to understand the complexities of the construction sequence and structural details of these ships and determine their fundamental characteristics in terms of total weight, weight distribution, displacement and trim;
- c) To assess their sailing abilities under different weather conditions, in terms of stability, propulsion

force, resistance, performance, and maneuverability; and

- d) To assess the ship's structural strength to extreme and fatigue loads.

To achieve these goals we established thirteen tasks:



Lines drawings of the Pepper Wreck.

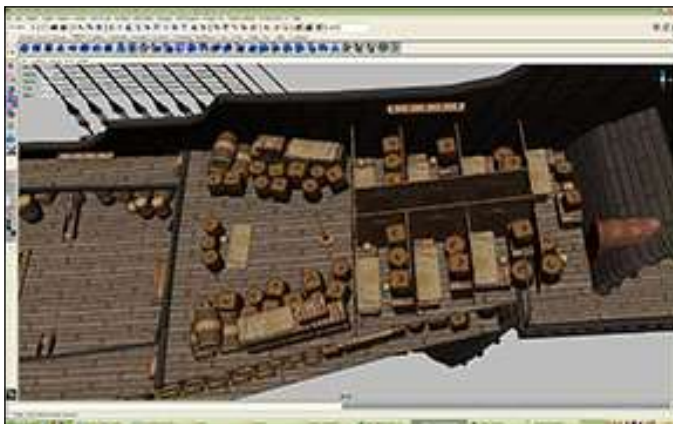
T1 - Development of a set of hull lines, sail plan and rigging plan

This task entailed an analysis and fine tuning of the existing lines drawings, and the development of the masts and spars plan, sail plan, and rigging plan.

Several models were developed and discussed.

T2 - Design of the ship's structure, including space divisions and internal bulwarks

A three-dimensional model of the ship's structure was created based on the model developed by Alex Hazlett, as well as a theoretical internal subdivision of the spaces. The weights and centers of gravity of each timber piece were entered, using the different specific densities of the various kinds of timbers used. A definition of the interior spaces was developed to allow the estimation of the cargo capacity, weight, and distribution of the cargo and ballast for each loading configuration.



Audrey Wells model.

T3 - Stability analysis

This task comprised the assessment of the floatability and stability of the ship for several loading conditions.

Firstly the intact stability was investigated by modern computational methods, including small-angle and large-angle stability. The results were then compared to current stability criteria for large sailing vessels, allowing an estimation of the actual safety of the ship. We plan to investigate the stability during and after flooding (damaged stability), and to discuss the effectiveness of the crew countermeasures described in contemporary documents.

T4 - Hydrodynamic model tests in towing and seakeeping tanks

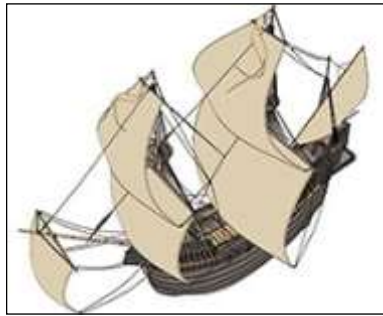
This task entailed the construction of a 1/10 model for:

- resistance tests, where the model was towed in still water at several speeds to measure the resistance to the advance;
- sea-keeping tests, where the model will be towed in regular and irregular waves to measure the induced motions and added resistance to the advance due to the waves; and
- maneuvering tests where forced horizontal motions are imposed on the model to obtain the hull manoeuvring characteristics.



Inspecting the ship's interior space at the C.A.V.E.

T5 - Aerodynamic tests in wind tunnel with sail model

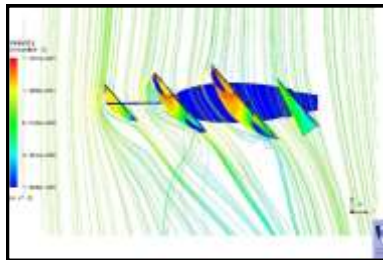


Audrey Wells model.

A model of the hull's upper works and rigging was built and will be tested in a wind-tunnel, with different wind conditions such as various wind directions.

These tests will be carried out considering only the sails (in several configurations) as well as the sails together with the hull's upper works, since it is known that the size of the fore and stern castles of these ships influenced their performance under sail.

The results will be used to calibrate the theoretical model built in task 6.

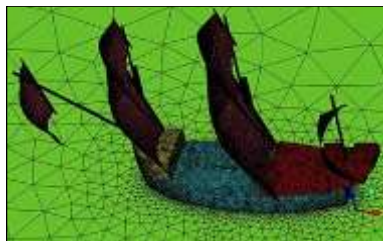


Aerodynamic tests at CMTE.

T6 - Calibration of the theoretical models for ship dynamics

CMTE has developed and implemented software based on several theoretical models that calculate the dynamic behavior of ships at sea: resistance to advance, seakeeping in waves, maneuvering and sailing performance.

However, these models are at present adequate for modern conventional ships and vessels. Those modern models will be calibrated and validated to represent the dynamics of the Pepper Wreck, by systematic comparison of results with tank and wind tunnel data.



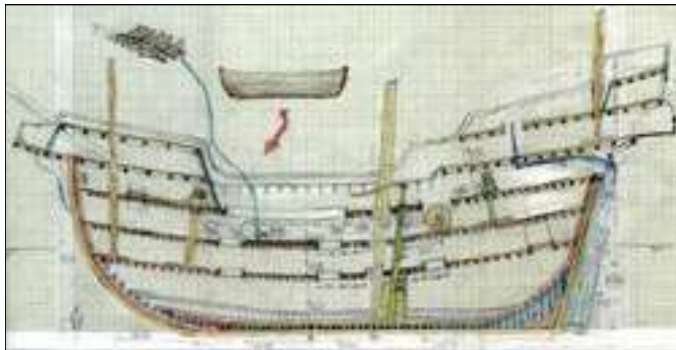
Numerical simulations of the reconstructed ship at CMTE.

T7 - Calculation of the Polar Diagram of Speeds

This task will consist of the calculation of the polar diagram of speeds, a graphic that indicates the speed attainable for each direction and wind force combination. In addition to the sailing speed and direction, UETN software will find the heeling, drift and rudder angles, while sailing in equilibrium for each situation of wind intensity and direction and sail configuration.

T8 - Assessment of the India Route various paths

Considering the patterns of wind and currents for



Sketch with the decks and internal division of spaces.

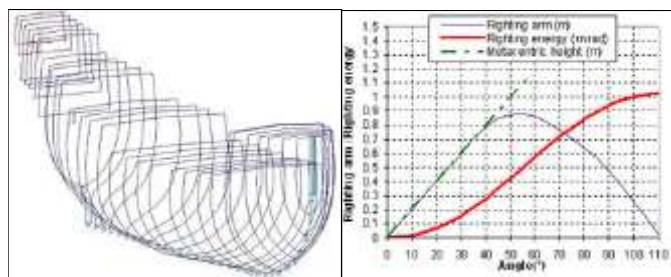
the Atlantic and Indian Oceans during the periods in which these ships sailed from Europe to the Indian Subcontinent and back, an attempt will be made to simulate a full round voyage and determine the speeds and times traveled during each leg.

A critical analysis will be performed in order to assess if the route chosen by the Portuguese pilots was in fact the best possible solution given the ship's characteristics and the calendar restrictions imposed upon the trips - a complex set of restrictions that were related with the harvest and cure of the peppercorns in India, the prevalent winds of each monsoon, and the pathway of the cash flows that fuelled the commerce.

T9 - Assessment of the ship's structural strength

The model built in tasks 1 and 2 will be used to study the structural strength of these ships. Almost nothing is known about this subject other than that the scarcity of suitable timber for shipbuilding that characterized this period made these ships very interesting subjects of study from the optimization-engineering point of view.

Structural loads imposed by severe weather, transmitted to the hull structure by both large waves and by the rigging will be analyzed and compared with the structural strength expected for the model, given the timber sections utilized, the types of connections, scarves, and fastening patterns.



CMTE model of the Pepper Wreck and its righting moment..

Fatigue will also be analyzed since these ships were subjected to violent and repetitive stresses during long periods of time-frequently over one month-during their six to nine month's trip. One of the most interesting aspects of this study will be to assess the influence of heterogeneity of the timber, as a construction material, in the final strength of the ship.

A computer model based on Alex Hazlett's was developed by CMTE student Tomás Vacas (Rhinoceros®).

T10 - Creation of a virtual reality model

A three-dimensional virtual model was designed by Texas A&M VizLAB student Audrey Wells (Autodesk Maya®) to provide both the investigators and the target public a better understanding of the interior space distribution, living conditions, sailing performance and maneuvering.

This model allows the representation of spaces and environments of indubitable interest, both for the scientist's understanding of the ship under study, and for the public targeted in the dissemination of the study's results.

T11 - Virtual Reality Simulations

We expect to develop this model further and use it together with the mathematical models to recreate a series of typical situations routinely encountered by an India nau, such as: maneuvering, including reaching, beating, changing tack, stopping; the dynamics of the ship under several different sailing conditions; the inflow of water which might result in sinking, including the measures taken by the crew; simulation of the construction process; the operation of launching; simulation of the careening of the ship.

T12 - Construction of a scale model

This task consists on the construction of a wooden scale model of an India nau. These models permit a better understanding of the ship shape and structure, based on the restrictions of the building materials.

Models allow scientists to understand the real possibilities of the timber utilized, the most important aspect being the simulation of bending directions of the wales, stringers, planking strakes, and the influ-



Tow tank essays.

ence of this practical knowledge - today completely lost - on the conception and design of these ships. Each construction phase is being documented in video and digital photography.

T13 - Dissemination of the results

The objective is the dissemination of the results to two main target publics: the scientific community and high school teachers and students.

This task encompasses the publication of articles in academic journals, in magazines aimed at a wider public, the production of short videos for the internet, and an attempt to generalize the use of the VizLAB immersion software C.A.V.E.

This project has created numerous opportunities to develop a better understanding of the design and construction of the ships that opened the Asian markets to Europe.

The study of the ship's rigging and interior space is now object of a PhD dissertation in the ShipLAB and promises to create a base for a future assess-



Model with the masts and yards.

ment of the rigging arrangements used in these voyages, which as already mentioned, lasted six months through adverse weather conditions.

As a mere working hypothesis, the reconstruction of the Pepper Wreck still stands, unfortunately, as the only existing study on these amazing ships, which continue to be destroyed by treasure hunters around the world, often with the consent of governments and international institutions.

A number of extensively preserved Portuguese Indiamen have been worked by treasure hunters in Mozambique for over a decade and, judging by the images published by the salvagers.

As long as other shipwreck sites with enough hull preserved remain inaccessible to archaeologists, it



Model with sails.

will be impossible to test and complete our models.

Publications

A complete list of our publications is presented on pages 68-73, included in the Pepper Wreck Project.

PROJECTS

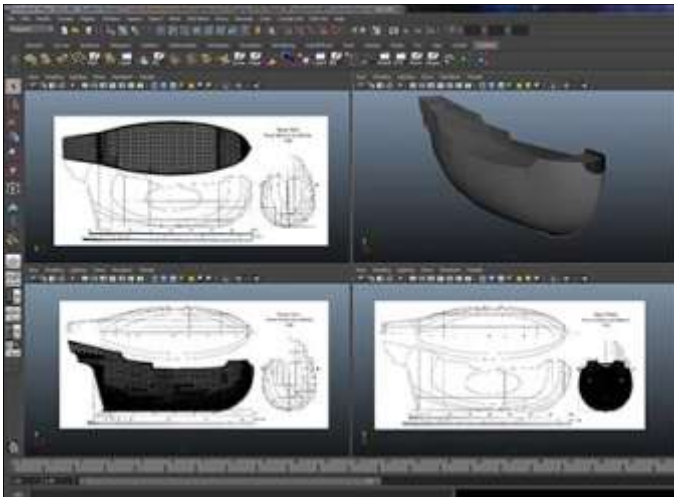
Modeling the Pepper Wreck

PhD, 2012-present

P.I.s: Kotaro Yamafune and Filipe Castro

The aim of this project is to reconstruct a 3D model of a 17th century Portuguese Merchantman based on both the archaeological data and historical documents, such as contemporary shipwright treatises, journals, and iconography. During the last decade, the quality and availability of 3D software has opened up new avenues of research in nautical archaeology. Commercial and open source software allows researchers to model and test their hypotheses about the complex spaces that form the interior of a ship.

Three-D software permits a quick and relatively easy implementation of changes, corrections, as well as the testing of hypotheses generated from unclear written sources, both textual and iconographic. Moreover, high-end reconstructions of archaeological ships are effective tools to discuss and improve knowledge about shipbuilding, both at scholarly and popular levels.



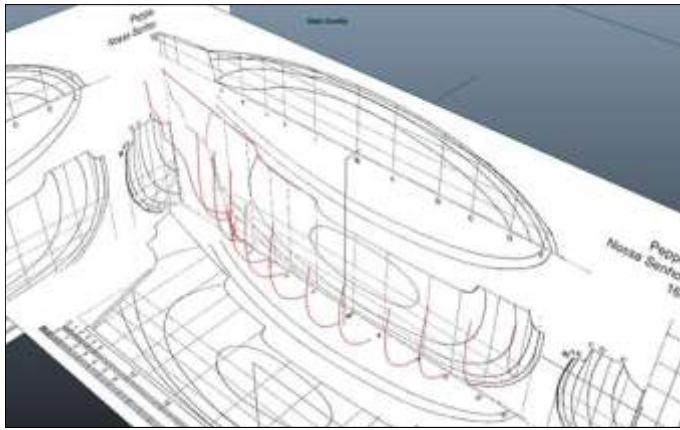
The design of the Pepper Wreck hull in Autodesk MAYA (Kotaro Yamafune).

I will attempt a full scholarly reconstruction of a large oceangoing ship based on the research developed in the Ship Reconstruction Laboratory from the data retrieved from the Pepper Wreck, an early



The hull, masts and spars ready (Kotaro Yamafune).

17th century Portuguese Indiaman lost near Lisbon on its return voyage from India. It has been tentatively identified as *Nossa Senhora dos Mártires*, lost in 1606. Although its authors admit that theirs is just a conjectural reconstruction, based on scarce archaeological remains, I have chosen this shipwreck because of the amount of data available about its conception, construction sequence, hull structure, rigging arrangement, crew, passengers, victuals, and cargo.

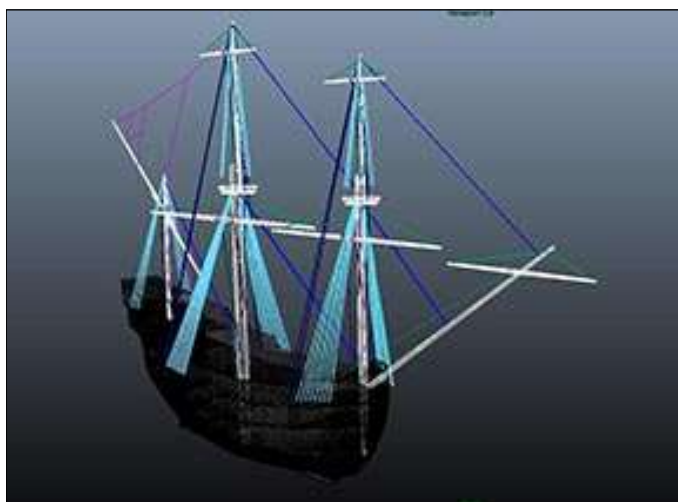


Set of lines used to model this version of the reconstructed Pepper Wreck (Kotaro Yamafune).

I plan to create a visualized anatomy of a late 16th or early 17th century Portuguese merchantman for both scholars and the general public, using archaeological and historical data. To achieve this goal my reconstruction of the ship shall be composed of the ship hull, rigging, cargo, as well as aspects of life on board, such as the space appropriation by crew and passengers.

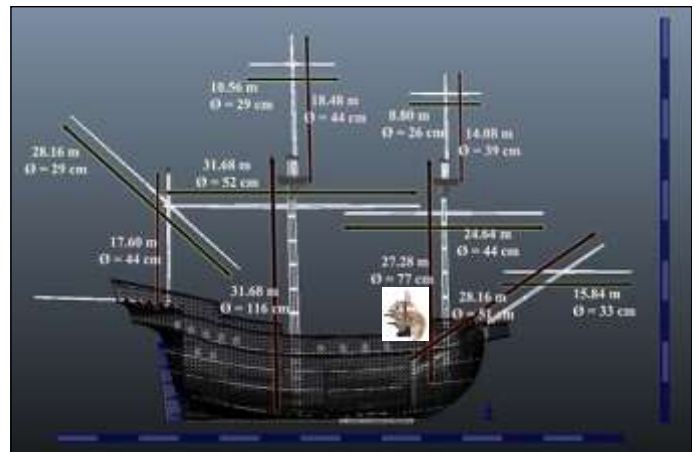
The cooperation between the Nautical Archaeology Program and the Department of Visualization (Vizlab) dates back to the mid-1990s, when the computer animation students developed models of the War of 1812 brig *Eagle*, reconstructed by Dr. Kevin Crisman, and the Dutch inland vessel Oost Flevoland B 71, dating to c. 1600 and reconstructed by Dr. Fred Hocker.

During the last decade the ShipLAB collaborated



Masts, yards, and Standing rigging (Kotaro Yamafune).

on another two projects with the Vizlab. The first consisted of a reconstruction of the interior volume of the Pepper Wreck (Audrey Wells) and the arrangement of the cargo and victuals, while the second explored the relations between the registered capacity and displacement in a 16th century Iberian merchantmen (Justus Cook). Both projects were oriented by Dr. Frederick Parke and Dr. Filipe Castro, and both have successfully demonstrated the



Dimensions of masts and spars. Kotaro Yamafune proposal.

enormous potential of the cooperation between the Vizlab and the Ship Reconstruction Laboratory.

A third project, Kelby Rose's reconstruction of *Vasa*, is now in progress and this project will be framed within the same theoretical lines using 3D software to develop a model of the Pepper Wreck. This model will synthesize all the present knowledge about this ship, summarize the most important remaining questions regarding its reconstruction, and present the data in a clear and easy to use way to both the scholarly and the general public.

Another project using computer graphics as a tool to better understand the conception and construction of a ship was developed in the ShipLAB by José Luis Casaban, and is a study of the Spanish almiranta *Nuestra Senora del Juncal*, lost off the coast of Mexico in 1631.

PROJECTS

Cais do Sodré Shipwreck

2001—present

P.I.: Filipe Castro

The Cais do Sodré shipwreck was found in April 1995, during the excavation works for the construction of a new subway station near downtown Lisbon, which is now the terminus of the Caravela line; named after this find. Dated to the 16th Century, these hull remains are an interesting example of a ship conceived with the whole molding method. The shape of the hull and the relation between its scantlings and its size are still a puzzle to researchers.

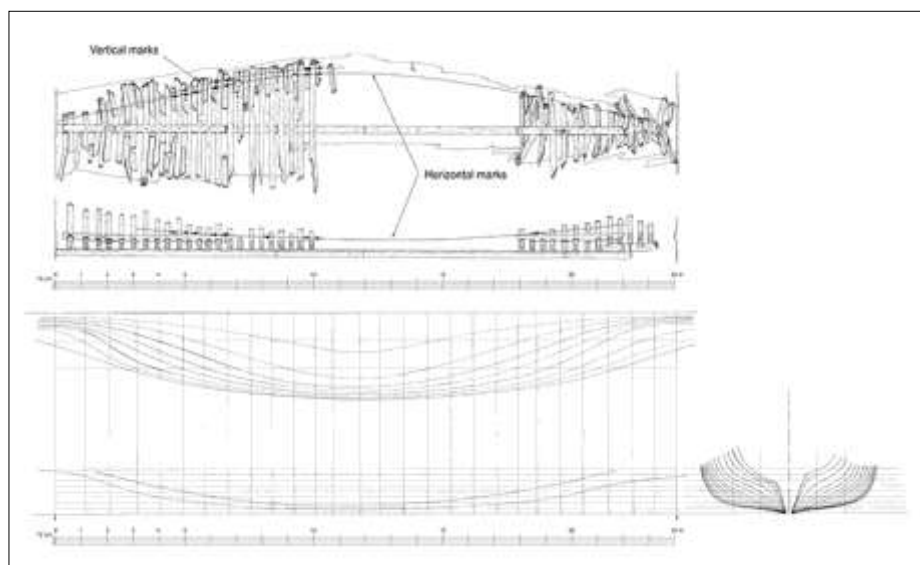
The Cais do Sodré shipwreck was found in April 1995 during the excavation works for the construction of a new underground station near downtown Lisbon, Portugal, which became the terminus of the line Caravela – named after this find.

Almost devoid of artifacts and showing few signs of wear on the outer surface of the keel and hull planking, the remains of this ship were lying horizontally at a depth of around -6.5 m below the water table, listing 14 degrees to starboard.

The wreck, which was presumably situated on an ancient riverbed approximately 120 m offshore from the Lisbon waterfront, is thought to have sunk around 1500.

The area where the ship was lying was eventually covered by a 19th century landfill (Figure 1). The orientation of a breast hook and the remains of a whipstaff suggest that the ship's bow pointed north, in the direction of the shore. As found, the hull appeared to have been heavily damaged by the

digging equipment. The upper sections of the structure were broken and showed no signs of exposure to natural marine environment erosion.



Turn of the bilge line, marked on the frames and lines drawings (Filipe Castro and Kotaro Yamafune).

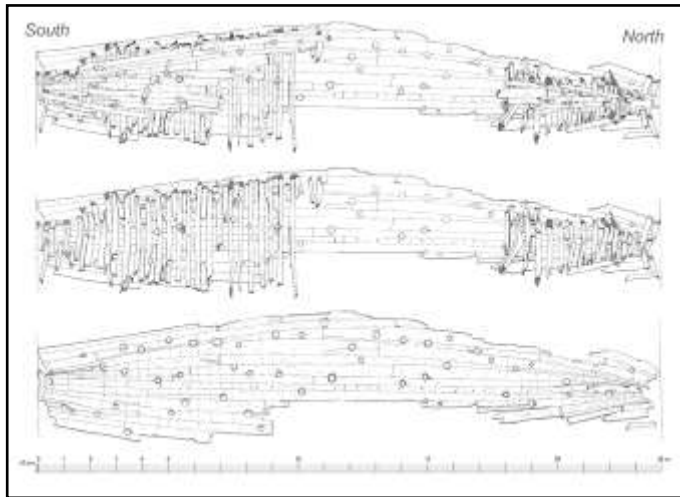
To extract the maximum amount of information of such a shipwreck site requires the construction of several models – educated guesses – and the testing of their plausibility.

We are planning to create a number of lines drawings that will be tested against known ship types. A

wooden 1:20 scale 3D model is under construction and two independent informatics 3D models have been started.

The next step in this project is the reassessment of the construction mark coordinates and a tentative interpretation of these in light of the known conception recipes for that period.

In the meantime, we have published the raw data and encouraged our colleagues to develop their own theories, models and reconstructions of this



Site Plan (Filipe Castro)

interesting shipwreck.

Mariangela Nicolardi (Sorbonne I) is developing a reconstruction of this ship based on the surviving frames, and Nick Budsberg is developing a wooden model of the surviving timbers to estimate the turn of the bilge curves and assess the most interesting feature of this ship: its entrances and runs are too low for the keel length.

Publications

Castro, F., Yamafune, K., Eginton, C., and Derryberry, T., "The Cais do Sodré Shipwreck," in *International Journal of Nautical Archaeology* (2011) 40.2: 328-343.

Rodrigues, P., Alves, F., Rieth, E., Castro, F., "L'épave d'un navire de la moitié du XV.^{ème} siècle / début du XVI.^{ème}, trouvée au Cais do Sodré (Lisbonne). Note Préliminaire", in Alves, Francisco, ed., *Proceedings of the International Symposium 'Archaeology of Medieval and Modern Ships of Iberian-Atlantic Tradition'*, Lisbon, 1998. Lisbon: IPA, 2001: 347-380.

Reports

Castro, F., and Yamafune, K., *The Cais do Sodré Shipwreck, Lisbon, Portugal – ShipLab Report 13*. On file in Nautical Archaeological Program Library, Texas A&M University, 2010.

Castro, F., *The Cais do Sodre Ship Frames – 2002 Field Season – ShipLab Report 4*. on file in IPA/CNANS' library, 2002, and in Nautical Archaeological Program Library, Texas A&M University, 2002.

Castro, F., *Relatório dos trabalhos de registo arqueográfico das madeiras do navio do Cais do Sodré, Verão de 2001*, on file in IPA/CNANS' library, 2001.

Communications at International Meetings

Nicolardi, M. and Castro, F. *Molds and architectural signs in the skeleton first construction: a methodology to reconstruct the original hull's shape of the Cais do Sodré shipwreck*. International Symposium in Ship and Boat Archaeology, Amsterdam, October 8-12, 2012.

Invited Talks

L'archeologia fluviale in Portogallo: il caso del relitto di Cais do Sodré, Convenio Internazionale "Storie di uomini e di acque," Aquileia, Italy, 24-25 February, 2012. Paper delivered by Massimo Capulli.

Castro, F., *The Cais do Sodré and Arade Projects 2002*. INA Annual Board Meeting, Dallas, January 2002.

Rodrigues, P., Alves, F., Rieth, E. and F. Castro. *L'épave d'un navire de la moitié du XV.^{ème} siècle / début du XVI.^{ème}, trouvée au Cais do Sodré (Lisbonne). Note Préliminaire*, International Symposium 'Archaeology of Medieval and Modern Ships of Iberian-Atlantic Tradition', Lisbon, 1998.

Newsletter Articles

Yamafune, K., and Castro, F., "Reconstructing the Cais do Sodré Ship," *CMAC News and Reports*, (2010) 2.2: 20-22.



3D planking plan (Coral Eginton)

PROJECTS

Traditional Shipbuilding Techniques at Baía de Todos os Santos, Brazil

2011—present

P.I.s: Filipe Castro and Denise Gomes Dias.

Step by step procedures for calculations of a ships' basic dimensions and shapes are known throughout the Mediterranean, and can be found in historical documents found along most of the northern coast of the Mediterranean, in the Iberian Peninsula, and in the New World. These solutions are generally referred to as "whole molding" and consist of the utilization of a small number of molds and ribbands to obtain – or repeat – a particular shape of a ship's hull with a reasonable accuracy. Before the development of lines drawings and lofting methods, the ability to repeat a certain hull shape was paramount to shippers and shipwrights. To build "by eye" did not provide any guarantee of precision, even to the most skilled shipwrights.

Saveiros

Swift, agile, elegant with their bright sails and colorful hulls, the *saveiros* were the blood that supplied Baía de Todos os Santos and distributed its manufactured goods throughout the cities and villages surrounding the industrial center. Sugar, manioc, pottery, coconuts, palm oil and spices were transported raw and processed, to and from the city of Bahia, since times long forgotten.



Anthropologist Pedro Agostinho (2011) made the case for the evolution of the colonial caravels through “the slower rhythm of cultural change,

[which] may have preserved until today many archaic structures, forms and techniques.” His seminal work was later re-edited with a set of magnificent images and established a history and a typology of these vessels.

Another brilliant scholar, John Patrick Sarsfield, traced a hypothetical evolutionary line that explains the introduction of the present gaff sails through Dutch influence and the name change from *caravela* or *caravelão* to *saveiro*. In the 1980s

Sarsfield brought these boats to Anglo-Saxon attention with three papers, and eventually had a “caravel” built by one of the shipwrights that used a version of the whole molding method.

Another seminal book was published by Lev Smarcevski, describing a particular recipe for the construction of *saveiros* in Taperoá, by a shipwrights named *mestre* João Bezerra. His method is condensed in a board, which includes the *graminho* and the scantlings of the most important timbers of a *saveiro*.

Valença

In December 2013 we visited Valença, the village where Sarsfield lived and worked, and interviewed a number of shipwrights. From this visit we designed a research project which aims at collecting and publishing this vanishing oral tradition.

At this stage of our research a number of pertinent questions remain unanswered, mostly in what pertains to the ships' scantlings, main dimensions, and proportions. Although each shipwright seems to have his own recipe to build a *saveiro*, the scantlings and main dimensions of the vessels we have surveyed seem rather constant. All shipwrights



Mestre José Crente preparing the molds to show us how he traces a midship frame (Filipe Castro)

agreed that the old *saveiros*, designed to sail on the sea, had considerably higher raising and narrowing values, as did mestre Waltinho's *Niña*.

The ancestry of each one of the active shipwrights seems tremendously important and must be addressed through an investigation of the parish archives. The generation that is now in their eighties had fascinating stories about the apprenticeship process where, for instance, the word vocation appeared more often than we expected.

Another interesting subject we have just started discussing is the size, age, and quality of the timbers available, the types of trees used in the construction of boats and ships, and the perceived durability and quality of each species. Together with the timber conversion, this subject promises to be a fascinating one. All timbers used to be cut with axes, from enormous trees, traced with chalk with the help of the futtock mold and a line to measure trees' diameters and timber lengths.

We hope to continue this project for two more years in Valença, and address a number of repeated subjects that we are presently in the process of inventorying, then evaluate our finds, and hopefully continue the study of the types of ships and boats in the region, and the adaptations introduced in their conception and construction.

Communications at International Meetings

Castro, F. and Gomes-Dias, D., *Whole Molding Construction in Baía de Todos os Santos, Brazil*. 48th Annual Meeting of the Society for Historical Archaeology, Seattle, January 6-11, 2015.

Gomes-Dias, D. And Castro, F., *Glossário ilustrado da carpintaria naval na Baía de Todos os Santos*. III Congresso Internacional de Dialectologia e Sociolinguística. Universidade Estadual de Londrina, Paraná, Brasil, October 7-10, 2014.

Castro, F. and Dias, D. G. *Graminhos and the Transmission of Knowledge in Portuguese Shipyards during the Early Modern Age*. XVIth International Reunion for the History of Nautical Science. Bremerhaven, 3-6 October, 2012.

Dias, D. G. "Memories from the sea: linguistic and ethnographic sources for Bahia's nautical history." *XVth International Reunion for the History of Nautical Science*. Ferrol, 4-6 November, 2010.

Gomes, D., *Os segredos da arte. Um olhar etnolinguístico sobre os carpinteiros navais do Baixo Sul da Bahia*. Bahia: UEFS Editora, 2009.

Dias, D. G. "No que viajam sobre a água: remanescentes da cultura náutica brasileira documentada em relatos de viagem do século XVI." *Do Brasil a Macau: narrativas de viagem e espaços de diáspora*. Lisboa, 10 a 14 de Setembro, 2008.

Publications

Castro, F., and Gomes-Dias, D., "Moulds, Graminhos and Ribbands: a pilot study of the construction of *saveiros* in Valença and the Baía de Todos os Santos area, Brazil." *International Journal of Nautical Archaeology* (article first published online: 16 DEC 2014, DOI: 10.1111/1095-9270.12086).



Spiling (Filipe Castro)

PROJECTS

Battle of Itaparica, Brazil

2011—present

P.I.: Rodrigo Torres

The Utrecht shipwreck site lies at a depth of 21 meters on a flat sandy bottom, 5 nautical miles (9.3 km) from Itaparica Island and 10.1 nautical miles (18.7 km) from the city of Salvador, northeastern Brazil. It sunk in 1648, together with the Portuguese ship Nossa Senhora do Rosário, in the battle that would later be known as the battle of Itaparica.

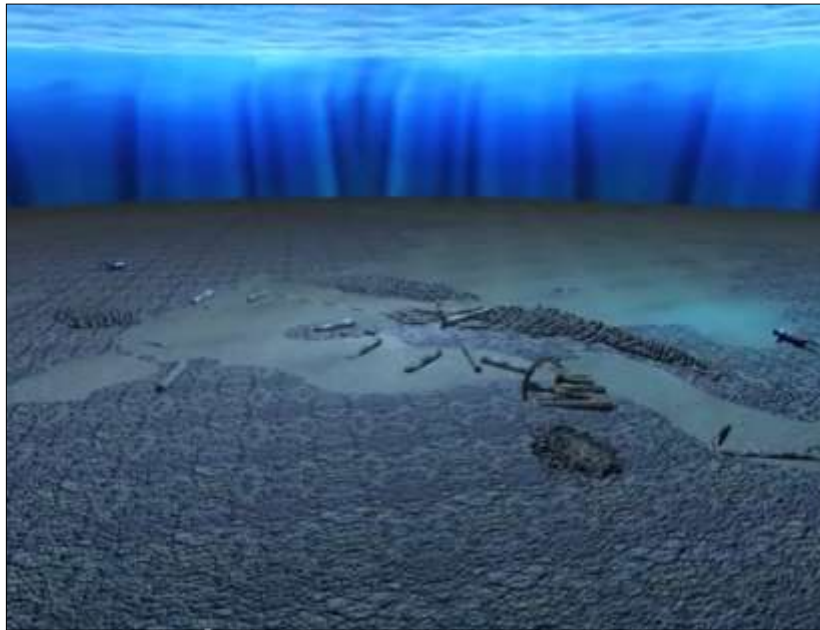
The Dutch ship *Utrecht* sunk off Itaparica Island, in the waters of the state of Bahia, northeast Brazil, after an engagement with the Portuguese vessels *Nossa Senhora do Rosário* (32 guns) and *São Bartolomeu* (32 guns) in the later period of the Dutch West India Company presence in Brazil. Incorporated in 1621, the West India Company was inspired by the success of the East India Company (1602-1798) and aimed at supporting the Dutch colonization and related commercial activities, which included privateering actions, in the Atlantic and Pacific Oceans.

In Brazil, the Company's business developed around sugar production and a highly profitable slave trade. The Dutch occupation of northeast Brazil lasted from 1624 to 1654 and constitutes a

rich period for the investigation of early modern geopolitics in the Atlantic.

On September 28, 1648, a Dutch fleet of seven sails under the command of Admiral Witte Cornel-

iszoon de With was patrolling an area off All Saints Bay, Salvador, Bahia, when it encountered two Portuguese sails coming in from the sea, around noon. The Portuguese ships were *Nossa Senhora do Rosário* and *São Bartolomeu*, whose mission was to patrol the entrance of the bay.



Screenshot from animation developed by Kotaro Yamafune from the pictures, videos and scaled sketches developed by Rodrigo's team.

During the battle that followed the ships *Utrecht* (32 guns) and *Nossa Nenhora do Rosário* (32 guns) sunk.

Their remains lie on the seabed, roughly 200 meters apart, at a depth of 18 to 20 meters. They have been heavily looted and salvaged by treasure hunt-



Screenshot from animation developed by Kotaro Yamafune based on the historical research pertaining to the history of the Battle of Itaparica, 1648.

ers, and their condition was not known in detail, although it was believed that these sites were still important, from a cultural viewpoint.



Measuring one of Utrecht's anchors (Photo R. Torres).

With the support of the Dutch Cultural Agency, a team from the ShipLAB carried out a small number of dives on this site in 2012, in order to assess the condition of the shipwrecks and the viability of an archaeological survey of the sites.

The site was thought to contain relevant cultural information and from the pictures and video taken, and using 3D rendering software, a series of maps and animations of the site were produced, evidencing its enormous educational potential.

An extensive artifact catalogue has been produced by Rodrigo Torres and further work is planned as soon as the permitting process is completed.

One of the strengths of this project is the fact that although it has been stripped of most of its artifacts, the site still contains enough information to justify further archaeological research, and perhaps even retrieve information from the hull remains preserved under the two ballast piles.

We expect the project to resume in 2016.

Reports

Torres, R., and Castro, F., *The Utrecht Research Effort*, Typed Report on File in the Ship Reconstruction Laboratory, Texas A&M University, 2012.

Youtube Videos

<http://www.youtube.com/watch?v=kCyFIRhOu4g>

<http://www.youtube.com/watch?v=3Tj6utJzbGs>

PROJECTS

The Nautical Archaeology of Puerto Rico

2008 - present

P.I.s: R. Fontáñez, G. Garcia, F. Castro

Puerto Rico is located on the northeast corner of the Caribbean Basin. Archaeological evidence suggests that the island's first inhabitants arrived between the years 7,000 and 4,000 BCE. Spanish colonization of Puerto Rico began in 1509, under the direction of lieutenant Juan Ponce de León. The strategic location of Puerto Rico was admired since the early 16th century by both friends and enemies of Spain. This project aims at understanding the country's maritime history and vocation through its shipwrecks. In 2008, in cooperation with the Instituto de Investigaciones Costaneras (IIC), a team from Texas A&M University surveyed the coast between the municipalities of Loíza and San Juan. In 2010 we relocated the site of the Rincón shipwreck in cooperation with the Consejo para la Conservación y Estudio de Sitios y Recursos Arqueológicos Subacuáticos, the University of Puerto Rico, and the Historic Preservation Office.

The coastal waters of Puerto Rico harbor the remains of thousands of years of human occupation.

The island played a key role in the first decades of European exploration of the New World, and the island's coasts and estuaries have preserved an extensive record of maritime history, before and after the arrival of the Europeans.

This project's objective is to study Puerto Rico's seafaring history by investigating its submerged cultural heritage, with a particular focus on the history of European ship-building.

Following a survey of the north coast between Loíza and San Juan, which yielded very important information and permitted the inspection of several shipwreck sites, in 2009 the *Instituto de Cultura Puertorriqueña* and the *Alcaldía* of Rincón invited Texas A&M University to excavate the Rincón Astrolabe Shipwreck (Rincón 1), but the presence of a

precious and fragile coral reef located very close to the purported position of the ship's ballast pile called for careful preparation.



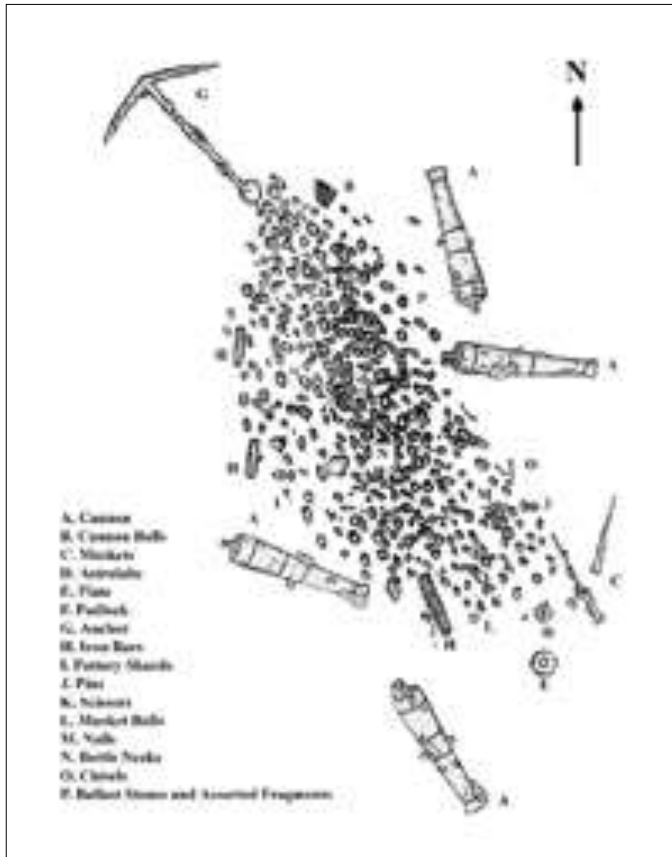
Surveying the area of the Rincón Shipwreck in 2010 (Photo: Juan Vera - Consejo para la Conservación y Estudio de Sitios y Recursos Arqueológicos Subacuáticos)

Moreover, some informants sustained that all shipwreck sites known in the area had been salvaged, including Rincón 1, and we felt the need to assess the site's condition before considering a full excavation.

In 2010, a joint team from the *Instituto de Investigaciones Costaneras* and the ShipLAB surveyed a small area on the west coast and searched for the famous Rincón Astrolabe Shipwreck,

believed by some to be *Defiance*, one of Prince Rupert's ships lost in 1652 with his brother Maurice on board.

Although the only written source leading to the identification of this site as the remains of *Defiance*, it is impossible to evaluate this claim without an extensive excavation of the site, which would



Site map sketch made by Richard Fontáñez, from the Puerto Rico Council for Underwater Archaeology.

endanger the coral reef already mentioned.

Only further research, namely on the artifacts, will add information to this shipwreck site.

Publications

Castro, F., Fontanez, R., Garcia, G., Tubby, R., Lusardi, W., "The Nautical Archaeology of Puerto



Last position of Defiance reported, on September 13, 1652, rather far from the purported shipwreck site.



Knife handle found on the beach in the year the Rincón Shipwreck was exposed (Photo: Filipe Castro)

Rico" *International Journal of Nautical Archaeology* (2010) 39.1: 156-164.

Reports

Castro, F., Fontáñez, R., Garcia, G., Tubby, R., and Lusardi, W., *The Nautical Archaeology of Puerto Rico, 2008 Field Season Report*, College Station, 2008.

Graduate Work

Gustavo Garcia, *The Rincón Astrolabe Shipwreck* (MA 2000-2005).

Newsletter Articles

Castro, F., Cartellone, C., Vera, J., Fontanez, R., Garcia, G., and Fontanez, A., "The Nautical Archaeology in Puerto Rico: Summer 2010 Field Work" *CMAC News and Reports*, (2010) 2.2: 11-13.

Castro, F., Fontanez, R., Garcia, G., Tubby, R., Lusardi, W., "The Nautical Archaeology of Puerto Rico", *INA Annual*, 2009: 72-79.

PROJECTS

Stella 1 Shipwreck, Italy

2011 - present

P.I.s: Massimo Capulli and Filipe Castro

The Anaxum project is a collaboration with the Dipartimento di Storia e Tutela dei Beni Culturali dell'Università di Udine and the Soprintendenza per i Beni Archeologici del Friuli Venezia Giulia. The project mission is the study of the River Stella, in Northern Italy, throughout time. In the summer of 2011, a team from ProMare, Texas A&M's Nautical Archaeology Program, and the Institute of Nautical Archaeology was invited to participate in the excavation of the Stella 1 Roman barge, directed by Massimo Capulli from the University of Udine and Filipe Castro from Texas A&M University, and under the scientific supervision of Luigi Fozzati of the Italian Ministry of Heritage and Cultural Activities. The excavation was made possible thanks to the generous support of ProMare, the Center for Maritime Archaeology and Conservation (CMAC), and Dr. Peter and Nancy Amaral, Texas A&M Alumni and long time supporters of the Ship Reconstruction Laboratory / CMAC.

Found in 1981 in the River Stella, near the villages of Palazzolo dello Stella and Preccenico, in Italy, the Stella 1 barge was dated to the first quarter of the first century CE based on the ceramic materials it carried.

Its planks were laced together and its cargo consisted mainly of roof tiles, both *embrici* and *copii*.

It was excavated in 1998 and 1999, and a more detailed recording was achieved in the summer of 2011. This report refers to the 2011 archaeological intervention on the shipwreck. This excavation is part of a wider project of study of the Stella River cultural landscape through time.

A number of models have been developed in the ShipLAB and we are currently trying to estimate the plausible size of this barge based on the cargo arrangement recorded in the 1990s, and the structural soundness of the boat.

The study of the artifact dispersion continued under the direction of Massimo Capulli. Other shipwrecks have been found in this area, and will be recorded and studied as part of the ANAXUM Project, a study of the River Stella and its region through time.



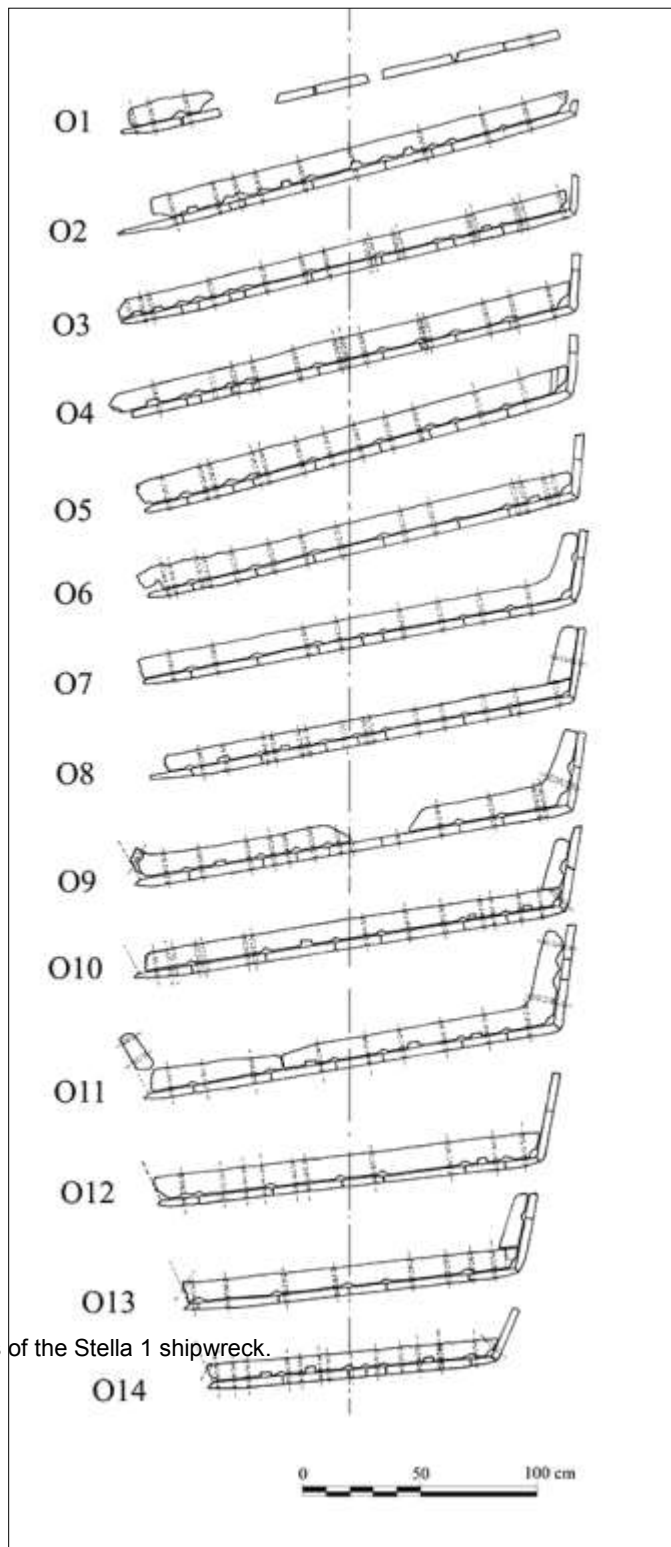
Stella 1 model at a 1:10 scale built by Ralph Singh-Bischofberger and Kotaro Yamafune in the ShipLAB.

Reports

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Communications at International Meetings

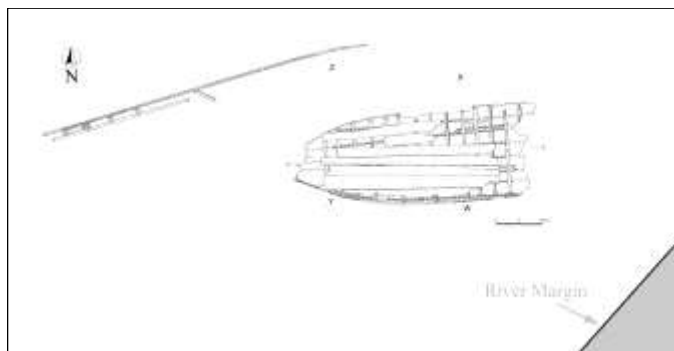
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Castro, F., Luigi Fozzati, Massimo Capulli, Ayse Atauz, Dante Bartoli, Kelby Rose, Lindsey Thomas, Kotaro Yamafune, Peter Holt, *The Stella 1*



The Stella 1 laced Roman barge as it was found in situ, with a piece of the mortise and tenon wooden structure, possibly from the embankment, lying nearby at a slightly lower level (Drawing: Filipe Castro)

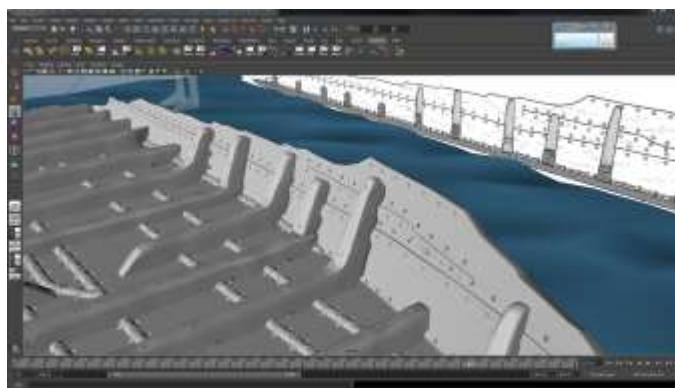
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AutoDDesk maya model of the Stella 1 shipwreck (Kotaro Yamafune)

PROJECTS

Asian Boat Models

2008 - present

P.I.s: Filipe Castro and Kotaro Yamafune

The Nautical Archaeology Program has two collections of Asian boat and ship models that are extremely rare, if not unique. In cooperation with the Center for Maritime Archaeology and Conservation, the ShipLab team is trying to raise funds to treat, conserve and study these models and make them available on-line.

The Nautical Archaeology Program owns two interesting collections of Asian watercraft models. These models are unique and their stories and quality justify their study and publication. Because some of these models are old, some conservation is required.

The Spencer Collection

The Spencer Collection was built in China between 1934 and 1940, and offered to Texas A&M University in 1974. It was made by a professional model builder from the port of Yichang, on the Yangtze River and encompasses a number of boats from the Yangtze River Basin.

It is composed of 29 boat models, all built after watercraft types that sailed on the Yangtze River. Their quality is excellent and their condition fair, although some of the sails have aged and the fabric is brittle in some cases. A book has been published by Joseph E. Spencer about this collection, explaining its acquisition and provenance, and all models are complete, with the boxes in which they traveled to the USA.

The Forrest H. Wells Collection

The Forrest H. Wells Collection was purchased in several Asian countries during the 1920s and 1930s, brought to America in the 1930s, and recently offered to Texas A&M University.

The Wells collection encompasses 42 models of several provenances and their condition is not as good across the board. Some models need conservation.

The models provenance is recorded and the collection came with a number of papers indicating the place of origin of each model (Samoa, Japan, China, the Philippines, Malaysia) and several pictures illustrating their condition over time. Most of the 42 models in the Wells collection are disassembled and need to be cleaned, conserved, and assembled. The study of the documentation will hopefully help us

identify each model and document its provenance.



One of the Forrest H. Wells' models.



Prototype in the SketchFab website. Experience by Kotaro Yamafune: the 3D model of this boat — from the Spencer collection — a was loaded to the SketchFab website and will allow the archaeologists to tag it and attach explanations of the boats and ships in these collections.

Publication

The aim of this project is to produce a 3D file of each boat and share them online, with the scholarly community and the general public.

We have contacted Dr. Hans van Tilburg in Hawaii and Prof. Dr. Qu Jinliang, the director of the Institute for Maritime Culture Studies and Sino-Korean Center for Maritime Cultures at Ocean University of China, and Profs. Cai Wei at Whuhan University of Technology, to help organize and coordinate the study and publication of these models.

We expect this project to last a minimum of two years, pending the funding we will be able to secure.

Once the conservation and assemblage of each model is achieved, the model will be photographed and its type, provenance, basic dimensions, and condition will be recorded. A three-dimensional scan will then be performed and the post-processing of the data will start. The ultimate aim is to get a full scale 3D file that

can be shared over the internet.

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Kotaro Yamafune and Shahab Mansoor work on the 3D model of one of Spencer's boats.

PROJECTS

Gnalić Shipwreck, Croatia

2011–2014

P.I.s: Irena Radić Rossi and Filipe Castro

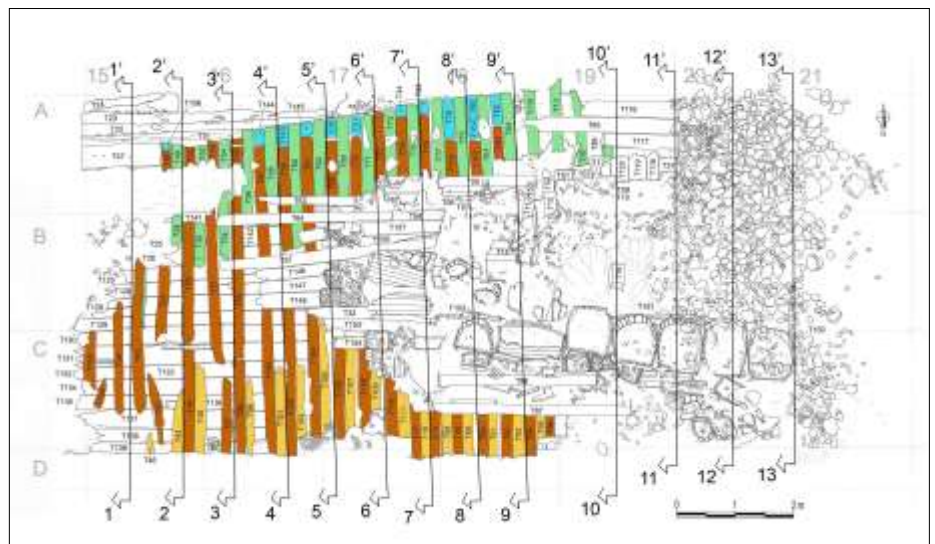
Directed by Irena Radic Rossi and Filipe Castro, the Gnalić Project is a multidisciplinary project promoted by the Municipality of Biograd na moru and launched by the University of Zadar, Texas A&M University, and the Forum of the Adriatic and Ionian Cities. The historic research is directed by Mauro Bondioli and Mariangela Nicolardi. It is supported by the Croatian Ministry of Culture, the Homeland Museum of Biograd, the Institute of Nautical Archaeology, the Center for Maritime Archaeology and Conservation at Texas A&M University, the Institute of Art History – Center Cvito Fiskovic in Split, the Museum of Ancient Glass in Zadar, the Faculty of Electronic Engineering and Computing of the University of Zagreb, the National Museum in Zadar, Croatian Historical Institute in Zagreb, University of Split, Department of Conservation and Ruđer Bošković Institute's Division for Marine and Environmental Research, the Polytechnic University of delle Marche, in Ancona, the University of Patras – Department of Geology, in Greece, the CNRS, both through the Musée de la Marine and the Laboratory of Sciences of Information and Systems at Marseilles, and the Museo della Marineria di Cesenatico.

The Gnalić shipwreck lies a little over three nautical miles from Biograd na Moru, Croatia. It was discovered by sport divers in the early 1960s, lying at a depth between 25 and 29 meters, near the Gnalić Island, at the entrance of the Pašman channel. Several archaeological interventions under the direction of Ksenija Radulić, in the late 1960s and early 1970s, and under the direction of Zdenko Brusić in 1990s, exposed the archaeological remains of a large ship dated to the late 16th century. The extension of the site and the amazing preservation of the ship remains and its cargo make it one of the most interesting early modern shipwrecks known.

The ship's preserved cargo consists of a rich assortment of glass vessels, mirrors, window panes, brass chandeliers, silk, cotton shirts, shaving razors, pins, needles, candle snuffers, brass bells, spectacles, and raw materials, such as cinnabar, lead carbonate, mercury, antimony, sulfur, brass

wire, and brass sheet. Determining the provenience and destiny of all these items will shed light on the nature of commerce routes in the eastern Mediterranean world of the late 16th century.

2012 Field Season



2013 Site map.

In the summer of 2012 a short archaeological campaign was carried out on the site, to assess the condition of the shipwreck, and plan a 3-year partial excavation. A small area of the site was excavated and recorded by a team from the Laboratory of Sciences of Information and Systems at Marseilles (LSIS), UMR CNRS 7296, under the direction of Pierre Drap.

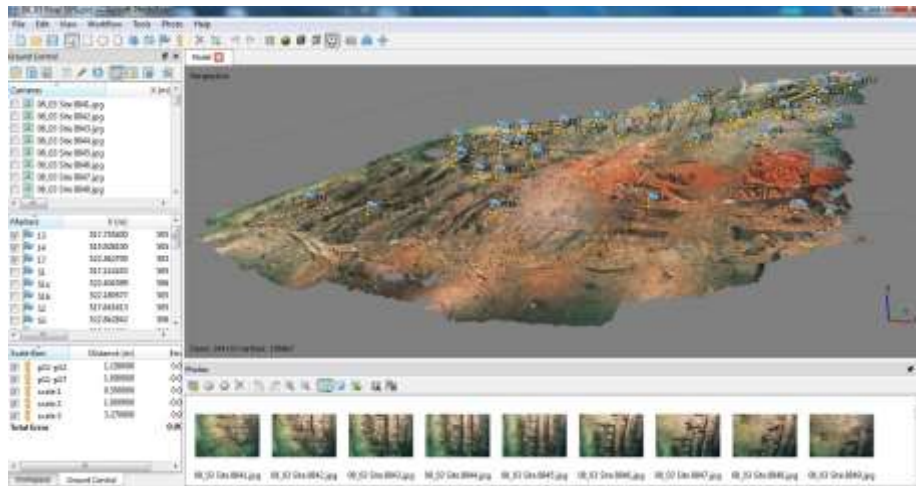
A blog was developed during the field season, and housed in the Institute of Nautical Archaeology website, who contributed with a subsidy for this fieldwork in 2012.

The artifact collection raised since the late 1960s was assessed, partially photographed, and a preliminary conservation plan was delineated, which encompassed the development of a comprehensive database in *Firefox Pro*, the software used in the Center for Maritime Archaeology and Conservation.

Although the area selected for the 2012 excavation had been excavated in the 1990s, a considerable amount of artifacts was found and raised, placing a certain emphasis on the conservation component of this project one year before our planning.

2013/4 Field Seasons

In 2013 and 2014 8-week field seasons were carried out at the Gnalić site, and a large area of the shipwreck was exposed. An area to the east of the shipwreck remains untouched and was surveyed. Surface finds - concretions - were tagged and positioned to be entered into a *ArchGIS*



Photogrammetry of the 2013 excavation season (José Casaban).

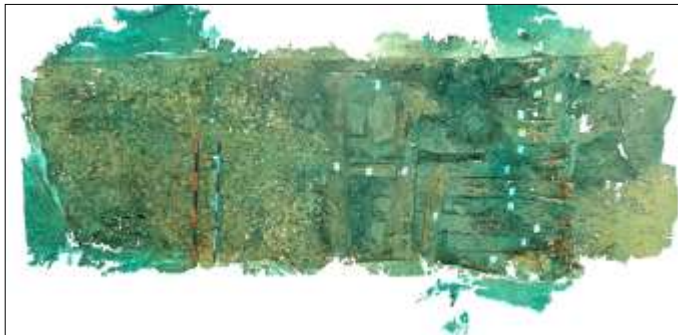
Database.

The site was recorded using off-the-shelf photogrammetric software PhotoScan, from which a number of files were developed, allowing a 3D treatment of the surface exposed in AutoDesk *Maya*.

Several full photogrammetric maps were developed with PhotoScan, containing the weekly exca-



Barrels are an important part of the Gnalić ship's cargo and their study promises to shed light on a number of interesting questions related to units and capacity estimates of the period.



2012 photogrammetric survey of the site (Pierre Drap).

vation progress for future analysis. A video of each of these 3D surfaces was produced using Autodesk Maya, and shared on-line in real time, together with a blog for the excavation season.

A scaled orthophoto was also generated, from which the 2013 site maps were drawn.

The development of the comprehensive artifact database continued, a protocol was established for the treatment and storage of a part of the collection, and an exhibition was organized in Zagreb, with a selection of the Gnalčić artifacts.

Reconstruction

No Venetian shipwreck from this period has yet been excavated and published, and at the end of the 2013 intervention it was not yet completely clear

what part of the ship's hull we had exposed.

The preliminary work towards reconstructing the ship's hull in this phase consisted on the collection of historical, iconographic, and archaeological data pertaining to Mediterranean ships of this period, which may or may not yield clues for the reconstruction of the Gnalčić ship.

A number of Autodesk Maya files have been developed, however, which allow us to visualize hypothesis and possible solutions.

Talks and Communications at International Meetings

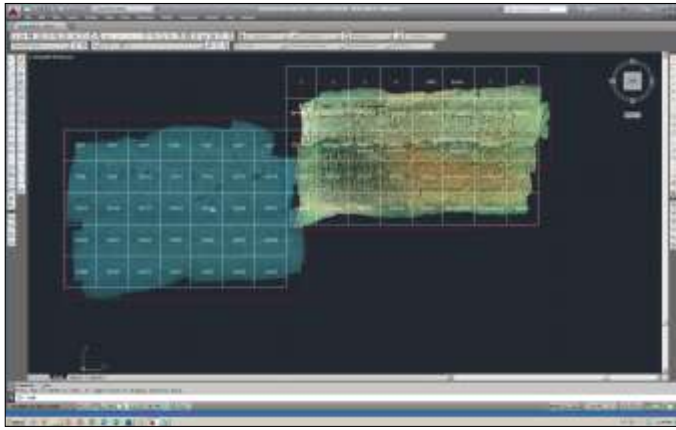
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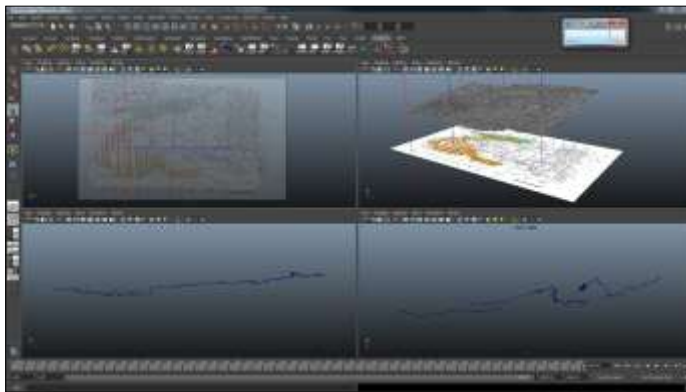
Screenshot of an animation video created in Autodesk Maya (Kotaro Yamafune).



Areas surveyed and excavated in 2013 (José Casaban).

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Longitudinal and transversal sections of the site excavated (Kotaro Yamafune).

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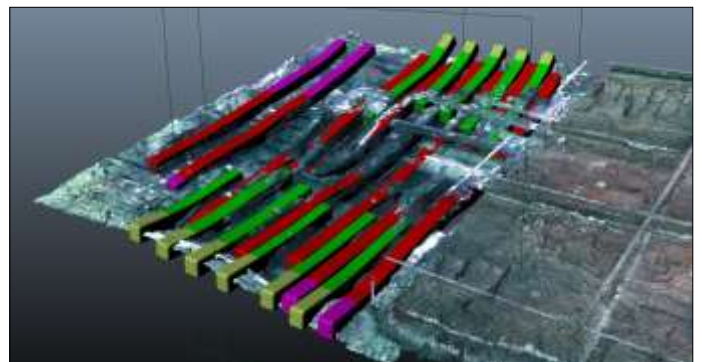
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AutoDesk Maya model of the timbers exposed in 2013 (Kotaro Yamafune).

PROJECTS

Lagos Project Portugal

2006 - 2007

In the nexus of the North Atlantic and the Mediterranean worlds, the Portuguese coast has a rich submerged cultural heritage. The ShipLAB organized a summer school in Lagos, Portugal, during the month of June of 2006, with the support of the municipality. Lagos has a long seafaring tradition and is the place where Prince Henry the Navigator lived and planned the first effective steps of the Portuguese expansion overseas, which lead to the discovery of a maritime route to India.

The **2006 Lagos Field Season** was an exploratory mission designed to introduce the landscape, the culture and the history of Algarve to a team of ShipLAB graduate students, and plan a long-term project of inventory, study, and publication of the region' maritime cultural heritage.

Six Texas A&M students participated in this summer school - Tiago Fraga, Paul Creasman, Bryana Dubard, Alexis Catsambis, George Schwarz, and Samuel Koepnick - and a seventh, Toby Jones, visited us from the UK.

Part of the student's time was spent recording artifacts raised by fishermen and sport divers, part diving on known shipwreck sites, and part visiting museums and archaeological sites, in order to acquire a sense of the magnitude of the work ahead: the inventory of the municipal submerged cultural heritage.

An inventory of known shipwrecks was started, based on national and local archives, as well as an inquiry and a list of local informants. An invento-

ry of historical documents containing references to shipwrecks in the region helped frame the research design, together with an inventory of the iconography related to ship losses and seafaring in the region.



Recording an anchor at Ponta da Piedade (Paul Creasman).

A visit to Pedras del Rei and the abandoned tuna fisheries was also organized to evaluate the possibility of recording the boats still in existence, which are rapidly rotting without any conservation care. This project was complemented with the collection of ethnographic data pertaining to the construction of these boats in the 19th and early 20th centuries.

Another important mission was carried out at Martinhal, where an unknown number of bronze guns have been salvaged by looters and there is a reference to an early 17th century Spanish shipwreck.

A symposium was organized, opened to the local public, in order to inform a wide group of volunteers about the nature and goals of the project.

Bureaucratic problems however, raised by the central agency of the Portuguese ministry of culture, made it impossible for the project to continue.



Pedras del Rei, old tuna fisheries (Paul Creasman).



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Stone anchors raised from a fishing site off Praia do Carvoeiro (Fiipe Castro, 2006).

PROJECTS

Playa Damas Shipwreck Panama

2003 - 2005

Found by sport divers in the 1990s, this shipwreck was mistakenly identified as Columbus' Vizcaína, a small 50 ton caravel lost near Nombre de Dios during his fourth voyage in 1503. In July 2003 Texas A&M University was invited to consider the complete excavation of the shipwreck at Playa Damas, located near Nombre de Dios, on the Atlantic coast of Panama. Unfortunately, this shipwreck was salvaged by a for-profit company between 2004 and 2006.

Following an invitation of the Panamanian *Instituto Nacional de Cultura*, in 2003, the ShipLAB tried to get an official permit to excavate an early 16th century Spanish shipwreck at Playa Damas, near Nombre de Dios, on the Atlantic Coast of Panama. The permit was denied in September 2005 and the shipwreck was later salvaged by treasure hunters, who kept a collection of the artifacts that has never been recorded, studied and published.

The site has been dated to the early 16th century, probably around 1530, and presented an amazing collection of artifacts.

The television chain Spiegel-TV made a documentary about this site and the ShipLAB attempts to dig it, and the magazine Der Siegel issued two articles and one book telling the sad story of this shipwreck site, which was associated to one of Columbus caravels by the treasure hunters, as it so often happens.

A considerable portion of the hull was preserved, and there is no way of saying whether this was the earliest shipwreck ever found in the New World or not.

After its destruction by treasure hunters, who never found any treasure, as it so often happens, the ShipLAB was invited to assess whatever was left by the treasure hunters, who asked a large sum of money and a share of "the profits" of its publication.

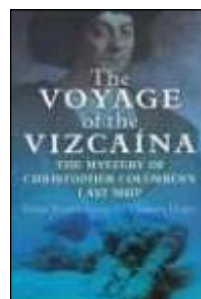
For several years after the destruction of the site, the ShipLAB tried to contact the Panamanian cultural agency in vain, asking to see a report that was allegedly filed by the treasure hunters as a justification of the salvage works.

At this point it is not known what is the site's condition. The collection, which included a precious collection

of iron guns, and rigging elements, including yard-knives, was housed in a private house near Cartagena de Indias.



Cannon ball and remains of an olive jar
(Karl Vandenhoe, Spiegel-TV)



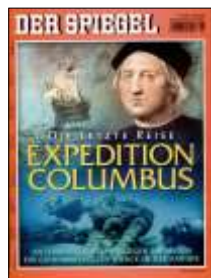
Book

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Documentary

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Brinkbäumer, K. and Clemens H., "Die letzte Reise des Columbus (II)", in *Der Spiegel*, No. 26, 21.Jun.2004.

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Playa Damas shipwreck (Karl Vandenhole, Spiegel-TV).



Playa Damas shipwreck (Karl Vandenhole, Spiegel-TV).

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PROJECTS

Arade 1 Shipwreck Portugal

2002 - 2003

First found during dredging operations in 1970, the Arade 1 shipwreck was photographed and inspected by amateur archaeologists in subsequent summers. Since there were very few artefacts, this wreck was eventually forgotten and abandoned. During the following decade the Arade 1 hull decayed, broke flat, and was covered by sediments. In the summer of 2001 Centro Nacional de Arqueologia Náutica e Subaquática (CNANS), the Portuguese agency for nautical archaeology, relocated the site and secured an agreement with the local municipality and museum for a long-term project of excavation, conservation and study of the Arade River underwater cultural heritage. In 2002 a team of students from the ShipLAB was invited to participate on the excavation of this shipwreck.

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Aspect of the frames in the bow area (Filipe Castro)

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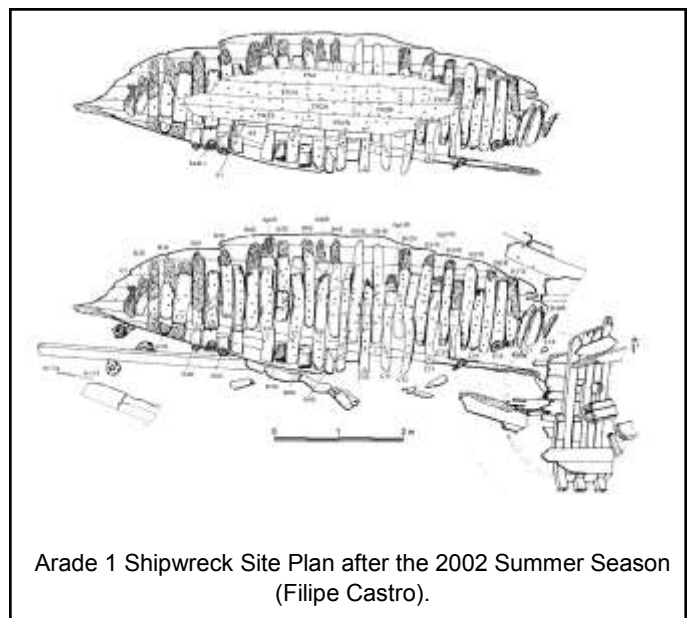
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Casella, G. M., Almeida, I. M., and Lacerda, M., *Trabalho de Investigação sobre peças de Estanho encontradas na Foz do Rio Arade (Portimão)*. Paper for the course of “Introdução aos estudos de arqueologia e da história de arte” at Faculdade de Letras of the Universidade de Lisboa, teacher Luís Manuel Teixeira, 1984. On file in IPA/CNANS' library.

Academic Work

Loureiro, V., *L'épave Arade 1 : l'influence des chantiers régionaux sur la tradition de construction navale ibéro-atlantique*. Lille: Atelier national de Reproduction de Thèses, 2012.



PROJECTS

Oeiras Guns Portugal

2000

Five iron guns were located during the preparation works for the construction of the Oeiras Marina, Lisbon, Portugal. This collection of guns was found to be part of a larger context, corresponding to a shallow shipwreck site dated to the 17th or 18th century, probably extensively salvaged immediately after its occurrence. The guns were removed to an area inside the jetties.

The Site

This site has been known to fishermen for a long time and its shallow location suggests that most of the shipwreck was salvaged over the years.

In the 1980s one gun presumed to come from this site was raised and placed in front of a house located nearby. It has since rotten away.

Sport diver Paulo Pimentel showed the team an adjacent area where in the winter, when the sediment blade is thinner, he found spikes and other small artifacts lodged in the crevices between the boulders that form the rocky bottom. The erosion on these artifacts, most from cooper alloys, suggests a long exposure to the currents and running sediments. Most of the shipwreck area lies now under the jetty.

The artifacts suggest a 17th or 18th century date, but it is impossible to say before they are studied and published.

This is, however, precisely the site of the loss of the India nau *Sto. Ignácio de Loyola*, which ran aground in this area in 1633, on its way back from India, after a difficult voyage.

It is likely that this ship was entirely salvaged and removed from Oeiras beach during the months that followed the shipwreck.



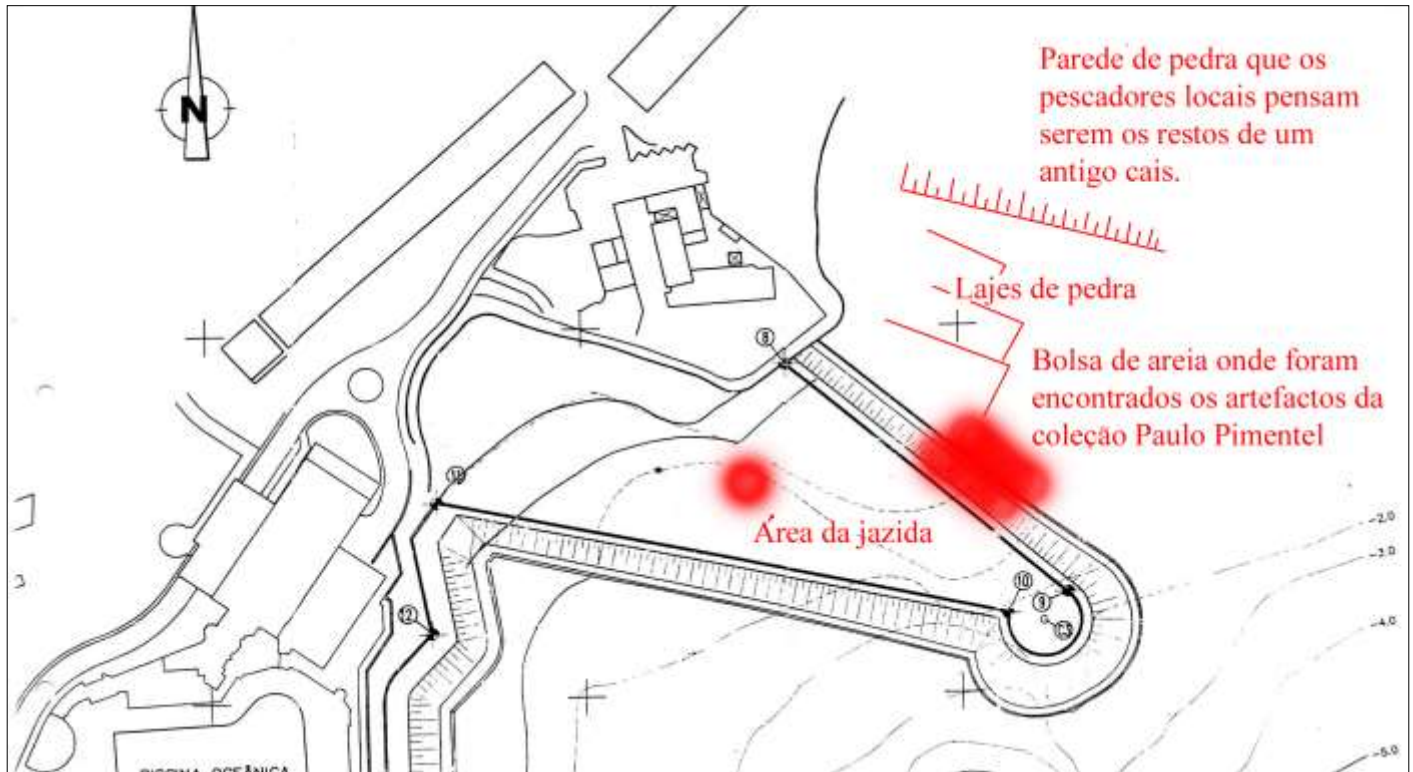
Area where the guns were found and the wider area where sport divers recovered several artifacts in the 1980s and 1990s.

In the summer of 2000 the ShipLAB was involved in the recording and rescue operation of a cluster of iron guns, which were concreted to the bedrock in an area that was going to be covered by

one of the jetties of the Oeiras Marina.

The guns were removed and deposited in an area nearby, and summary measurements were taken, as well as photographs, although the low visibility did not permit a photographic coverage of the site.

The municipality of Oeiras and the contractor



Plan of the site where the guns were found, and the area where artifacts were found (Filipe Castro).

stopped the work and hired an underwater contractor to remove the guns, which were solidly concreted to the rocks.

A few test pits were opened around the site where the guns were found, but the thin layer of sediments did not contain any artifacts in the areas inspected.

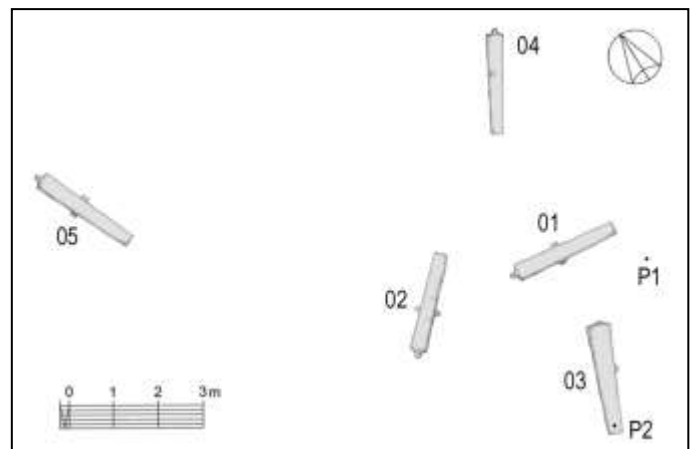
The guns were heavily concreted and thus difficult to measure, but their lengths varied between 2.1 m and 2.32 m.

Report

Castro, F., *Relatório dos trabalhos de salvamento de 5 bocas de fogo em ferro encontradas na zona de implatação da Marina de Oeiras*, on file in IPA/CNANS' library, 2001.



One of the guns in situ, concreted to the bedrock, before removal (Photo: Guilherme Garcia).



Plan of the site (Filipe Castro)





Research:

Ongoing Graduate Work

ONGOING GRADUATE WORK

Samila Ferreira

Policies of Memory, Politics of Forgetting. São Lourenço do Sul, Brazil

PhD, 2013 - Co-Chair: Tom Green

Samila Ferreira's research focuses on heritage policies, the enhancement of social memory and its effects on the representation/oblivion of social groups in multicultural/multiethnic contexts. In her work she analyzes public policies in view of their effects towards constructing and promoting narratives of the past. Language, power, and politics make our past, and public policies, monuments and legislation are the tools with which the narratives are created by every generation.

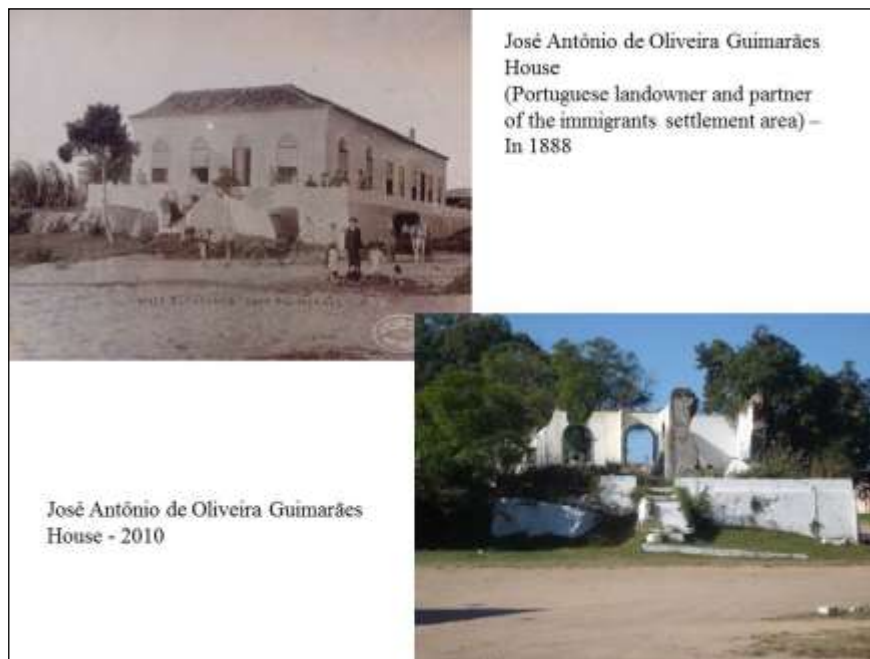
The city of São Lourenço do Sul in Brazil is located on the west shore of the Patos Lagoon. The city began to receive free laborers in 1858 with the arrival of immigrants from different parts of Europe, especially Germany and the now extinct Pomerania, occupying and cultivating agricultural properties in southern Brazil. Early on this colonial enterprise came to depend on water transportation for the transport of crops from and supplies to the farms. This transport was done with sailing schooners, regionally known as *Iates*, thereby integrating the colonial region with other navigation lanes into the Patos Lagoon. Over the years, the demand for schooners in this trade attracted many *Iates* to São Lourenço do Sul city, whose operation expertise and seamanship was mostly Portuguese.

Since 2005, the municipal administration has officially developed public-private collaborations in order to disseminate and promote the German-Pomeranian immigrant culture in the towns and region. This initiative, mainly linked to tourism,

has emerged as an economical alternative for the descendants of immigrants living in the rural area. The area experienced frequent economic swings as production declined and a colonial monoculture, especially tobacco, was established, impoverishing the local population. Since the

1970's a rural exodus of many young people is taking place, who seek for opportunities outside of the rural context.

In this study the interaction of at least two ethnic groups with the Portuguese is highlighted. According to Llorenç Prats all expressions of cultural



identity are ideological in the sense that they are based on narratives, ideas, values and prejudices. Collective memories in any single community are frequently different for different social and cultural groups, and the state sponsorship of any particular narrative risks the establishment of a collective memory that silences important voices or historical events.

We will discuss the problems related to the establishment of official narratives, collective memories and collective amnesia, and their relations with the social, cultural, economical and political factors at



São Lourenço do Sul, Brazil.

play.

As Foucault suggested, individual and collective identities are the result of our experience and most people accept the reality that the media and the existing institutions present. In this sense, all collective memories silence important parts of the past and represent only the version of the ruling class serving their specific purpose.

Morality, truth and meaning depend on knowledge and experience, and are embedded in culture, with its consensus and collective narratives of the past and the relations between the different cultural and social groups interacting in any given community.

We will frame the question of collective memory as well as collective amnesia in São Lourenço do Sul, in the cultural, social and economical context of this multicultural community. We will then analyze the construction of collective memories and consciousness in the social context of the different



powers at play between the dominant and subordinate groups.

Publications

Ferreira, S. P. "O espaço portuário da cidade de São Lourenço do Sul: um lapso de memória?" In: Michelon, F. F.; Lima, P. G. (Org.). *Cadernos Memória e Patrimônio: políticas e acervos*. Pelotas: EGUFPel, 2009, p. 251-264.



Clockwise: (1) Aboard in the late *Jaguarão*; the man wearing the white clothes is the late's master, at the helm is a sailor, the boy in the background holding the rope is the apprentice, and the man sitting in the background is the renowned photographer of that time, Bruno Pruské. Undated, author's personal collection. (2) Personal tools of sailor Mr. Lourenço Martins. From left to the right: thimble, fid and small knife for cutting up points. Recorded by the author on 01/04/2010. (3) Roveré Shipyard workers in São Lourenço do Sul. Undated. Mrs. Iolane Roveré Montezuma Personal archive. (4) Roveré Shipyard workers repairing the late *Federal*. Undated. Mrs. Iolane Roveré Montezuma Personal archive.

ONGOING GRADUATE WORK

Samuel Cuellar

A History of Ship Bells

PhD, 2012 - present

The early use of bells on ships may be related to the necessity of signaling a vessel's presence in the fog. However, only a handful of ship bells are known historically and archaeologically from the period dating before AD 1705. To make better sense of the centuries represented, we sorted them by date below along with its known information.

The goal of this study is to determine when, where, and why bells appeared aboard ships in Europe, sometime prior to the mid-to-late 15th century.

Both archaeological and historically known bells will be used to analyze religious, practical, and decorative functionality in relation to shipboard life and as compared to know land-based bells in churches and elsewhere.

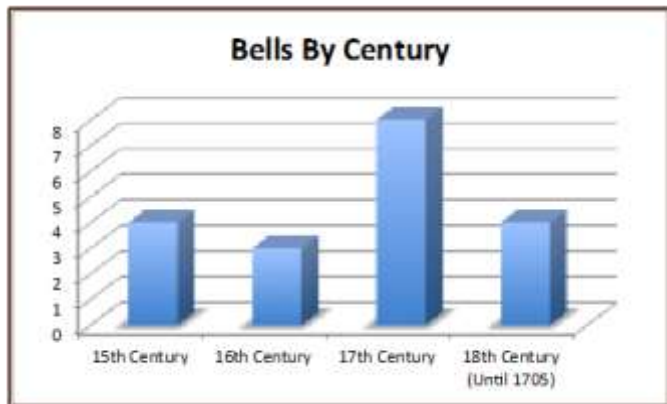


Bell allegedly recovered by sport divers from a shipwreck site near Figueira da Foz, Portugal, possibly the Spanish ship *San Salvador*, lost in that area in 1555 (Courtesy CNANS).



Fragment of a bell from Cabo Raso, Portugal, from the site of the 1696 shipwreck of an Italian ship named *Grande Principessa di Toscana* (Courtesy CNANS).

By defining these factors, a better understanding of the circumstances leading up to their placement aboard ships can be realized. In addition, a survey of all known and accessible extant archaeological bells will be done to determine if certain characteristics can provide an accurate designation of date and country of origin. These will include size and weight, physical markings, inscriptions, decorative



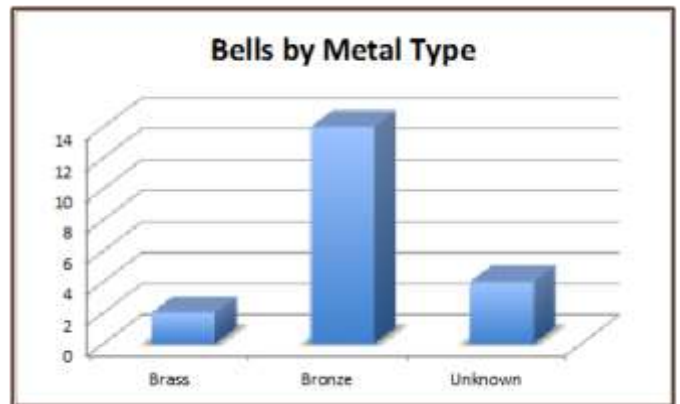
elements, metal composition, and shape and construction method.

A handful of ship bells are known historically and archaeologically from the period dating before AD 1705. To make better sense of the centuries represented, they have been sorted by date.

A database of all known information regarding archaeological and historical ship bells through 1750 is being developed to aid in determining the extent of relevant examples that have been discovered either through excavation, chance, or in historical archives. It is hoped that by sorting these bells by date, country, metal composition, and stylistic features, a better understanding of ship bell evolution will be revealed. Another goal of this database is to provide quick and easy ac-



Possible fragment of a bell from São Julião da Barra, Portugal (Courtesy CNANS).



cess to information for researchers. By providing a centralized location of known ship bell data, identification of a shipwreck's time period and country of origin may prove expedited through



Spreadsheet with basic information on bells (Sam Cuellar).

the use of the bell, if found.

The successful creation and completion of this database depends on the accessibility and accurate reporting of ship bell data. In several examined archaeological reports, data provided are either incomplete or missing in its entirety, other than a passing mention a ship bell was recovered. Likewise, bells have been recovered by local fishermen, treasure hunters, and sport divers and rest in private collections or are housed in museums where they sit unstudied. Bringing these sources to light is essential to an accurate picture of ship bells prior to 1750.

At this stage of the research we are collecting data from archaeological publications, historical accounts, and iconographical evidence.

We hope to gather enough information to reconstruct the history of ship's bells in the North Atlantic and the Mediterranean.

ONGOING GRADUATE WORK

Nicholas Budsberg

Renaissance and the Ships of Discovery

PhD, 2011-

The Iberian discoveries are part of the Renaissance cultural revolution, and its ships and boats cannot be studied outside this context. Connected by the sea, during the 15th and 16th centuries the world as seen by the Europeans never stopped growing. Although the ships of exploration do not seem to have gathered much attention from the intellectual elites until later in the 16th century, it is likely that the desire for learning and discovering that framed this period impacted their conception and construction.

The economic advantages of the newly opened maritime trade routes were obvious. Although sailing around the African continent was a long and dangerous endeavor, a small ship with 150 tons of capacity could carry the cargo of 1500 camels and stay away from most thieves, warlords, tolls and taxes.

During these two centuries the conception and construction of ocean-going ships evolved and blended along the Atlantic coasts of the Iberian Peninsula, a region situated on the nexus of two diverse seafaring worlds: the Mediterranean and the North Atlantic and Baltic.

What emerged from this 'Atlantic Tradition' was a flush-laid, skeleton-built, two or three-masted vessel that paired new arrangements of square and lateen sails for its rig. Construction details and phases, or transitions in development, are still largely unknown, and the answers

to these questions and others can only be found through archaeological research.

This project proposes to gather and research the available archaeological data pertaining to

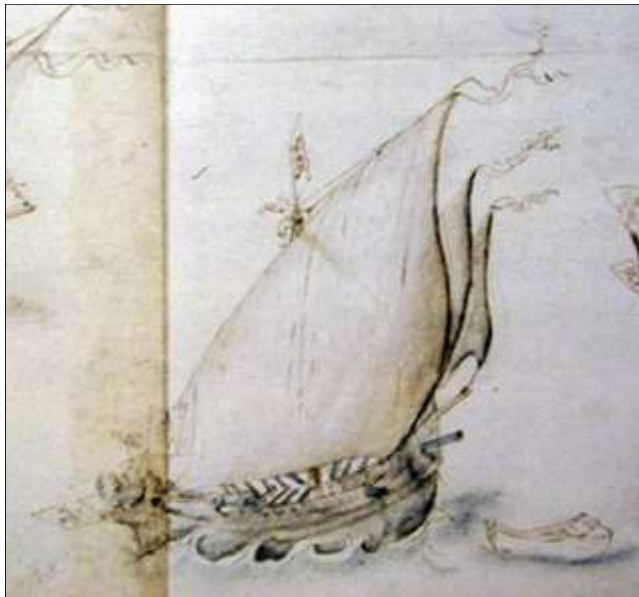
15th and early 16th century ships and interpret and evaluate it in the context of the cultural, economic and political history of Europe.

Modern nautical archaeology has contributed much to Iberian maritime studies since the field's inception in the 1960's. Initial research into early European shipwrecks in the New World

began in the 1980's and continued into the 1990's with students from Texas A&M, although historical research into this time period dates back to the late 19th century with the coming 400th anniversary of 1492. The public's interest with Christopher Columbus, the *Nina*, *Pinta*, and the *Santa Maria*, and other



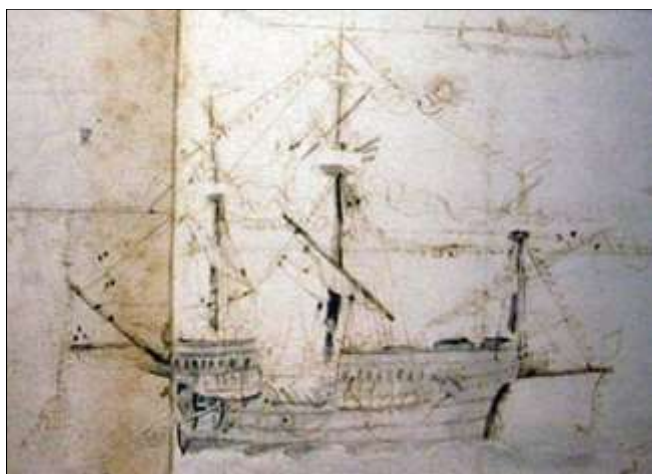
It is said that the keel of one of Amerigo Vespucci's ships hang from the ceiling of Lisbon Cathedral—together with other curiosities from the Portuguese discoveries—until the earthquake of 1755.



Armed lateen caravel in the Leiden view of Lisbon, dated to the 1530s.

contemporary explorers and their ships has not dwindled over the years, as many recent studies and reconstructions have been done regarding these vessels and others, although not enough is known about the caravels and naos of the exploration period to accurately reproduce one.

This dissertation will focus on the shipwrecks that are currently known but have yet to be thoroughly investigated. In the New World the Highbourne Cay wreck has been partially excavated, the Bahia Mujeres shipwreck surveyed, and the Playa Damas shipwreck salvaged. Only one early 16th century shipwreck has been



Navio in the Leiden view of Lisbon, dated to the 1530s.



Above: 15th century cog graffiti on the walls of Batalha monastery, Portugal.

excavated so far – the Molasses Reef wreck in the Turks and Caicos – and the timber remains were scarce and partially destroyed by treasure hunters before the excavation. In Europe a handful of shipwrecks from this period has been excavated but not entirely published.



Remains of a 15th century ship found in Lisbon at Largo do Corpo Santo (Kevin Gnadinger).

We intend to inventory the information available and try to make sense of it in the context of the history of the Renaissance, as these were among most complex objects built in their time. Their study will teach us about our technological history and ingenuity, and will help us understand the first step in the history of globalization.

ONGOING GRADUATE WORK

Randal Sasaki

Research at the Battle of Bach Dang River, Vietnam (1288)

Looking at a history of any particular nation, there will always be a few historically significant events that shaped the ethos of the nation and its people. One such event, for Vietnamese history, is the battle of Bach Dang River fought in 1288 C.E.

In the late Middle Age, the Mongols were a powerful force in East Asia. The Mongol conquest of the territory under the Southern Song dynasty, in the late 13th century, was a dramatic event, as Southern China was the economic, cultural, and techno-



Satellite image of the battlefield.

logical center of the Asian world.

The Southern Song dynasty possessed the strongest naval forces in the region, and many ships were equipped with compasses and ordnance. A competent leader, that Kublai Khan conquered and subdued China, a deed that not even the native Han

Chinese were able to achieve. It was the first time that China was united since several centuries.

Khublai's achievements up to the failed invasion of Japan were almost a perfect record of successful accomplishments. After he learned about the failure of his plan to invade Japan, in 1281, Khublai began planning a third invasion of the Island nation. However, many of his officials opposed the plan – the people also showed their opinion through popular revolts. Khublai Khan eventually decided not to invade Japan, but as many ships had been already built he decided to invade Vietnam instead.

Khublai decided to send both land and naval forces against Vietnam in 1288. The Mongols had been interfering with politics in Southeast Asia for some time, and this was not the first time the Mongols invaded that country.

One must note this was the last time that the Mongols attempted conquest of Vietnam, and their failure represents a significant event in the country's history.

In Bach Dang battle the country of Dai Viet (today's Northern Vietnam) successfully defended the nation from the invading Mongol Empire. It is said that the Vietnamese set up a trap by planting numerous wooden stakes along the Bach Dang River and waited for the enemy's fleet to arrive.

By luring the enemy to the field of stakes at the changing of the tide, Vietnamese were able to immobilize the fleet and successfully crush the invading enemy. In the 1950s and 1960s, a large number of wooden stakes were discovered at the town of Yen Hung in Quang Ninh Province (location believed to be the battle site) and Vietnamese archaeologists determined that the stakes were indeed from the battle of Bach Dang River.

However, no artifacts from the battle - other than the wooden stakes - were found. In fact, there are still numerous questions to be answered. Did the battle really take place at the site? Where did the ships disappear? What were the main battle strategies, and why were the stakes placed where they are? In 2008, initiated by Randall Sasaki, in cooperation with the Maritime Archaeology Program at Flinders University and the Institute of Archaeology at Hanoi, created an international research team to answer these questions.



Bach Dang Stakes Displayed at National Museum in Hanoi .



Excavation conducted by Vietnamese Archaeologists.

A series of surveys and excavations have been conducted, supported by various organizations including the National Geographic Society.

Despite the fact that no shipwreck has been located as of yet, the project revealed many aspects of the Vietnamese battle strategies and led to the discovery of new "stake-fields" which are now registered as national historic sites.

The project has gained national attention in Vietnam, initiating other nautical and underwater archaeology related projects in the country.

Its importance lies on its relation with a wider project, developed in cooperation with Jun Kimura, a PhD graduate from Flinders University, aiming at establishing a taxonomy and evolution of Asian watercraft. For several years now, these two researchers have collected data, developed, and refined a typology of oceangoing Asian watercraft, which gets more complex and sophisticated as data about Asian ships and boats is found and retrieved.

Publications

Sasaki, R. et. al. "The Archaeology of Battle - Magnetic Survey of Bach Dang in Vietnam." *INA Quarterly* vol.39.

Sasaki R. et al. "Archaeological Survey of the Bach Dang Historical Battle Field" *INA Annual* 2011.

Sasaki R. et al. "The Bach Dang Battle Site Survey Project 2009." *INA Annual* 2009.

Diogo Botelho

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João Figueira de Cairros

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Research:

Concluded

Graduate Work

CONCLUDED GRADUATE WORK

Kotaro Yamafune

Using Computer Vision Photogrammetry (*Agisoft PhotoScan*) to Record and Analyze Underwater Shipwreck Sites

PhD, 2012—2015

In recent years, applications of Computer Vision photogrammetry became popular in maritime archaeology. This technology has been repeatedly tested in archaeological surveys and excavations, both in dry and submerged environments. Yet, there are still active discussions about the efficiency and accuracy of photogrammetry models. With a team from the Nautical Archaeology Program at Texas A&M University, the author developed a methodology to record and analyze underwater shipwreck sites with off-the-shelf software, including Computer Vision photogrammetry.

A development of traditional photogrammetry, Computer Vision photogrammetry does not require the traditional two-camera equipment and uses instead sets of independent images with a certain amount of overlap. This methodology produces reliable archaeological data based on 1:1 scale-constrained photogrammetry models, such as 2D site plans, from which archaeologists can extract GIS databases, and develop other working tools. These may include hull lines and timber catalogues. In the present dissertation, the author will analyze and develop methods to use data sets produced by photogrammetric models in the reconstruction of shapes and structures of archaeological ship remains.

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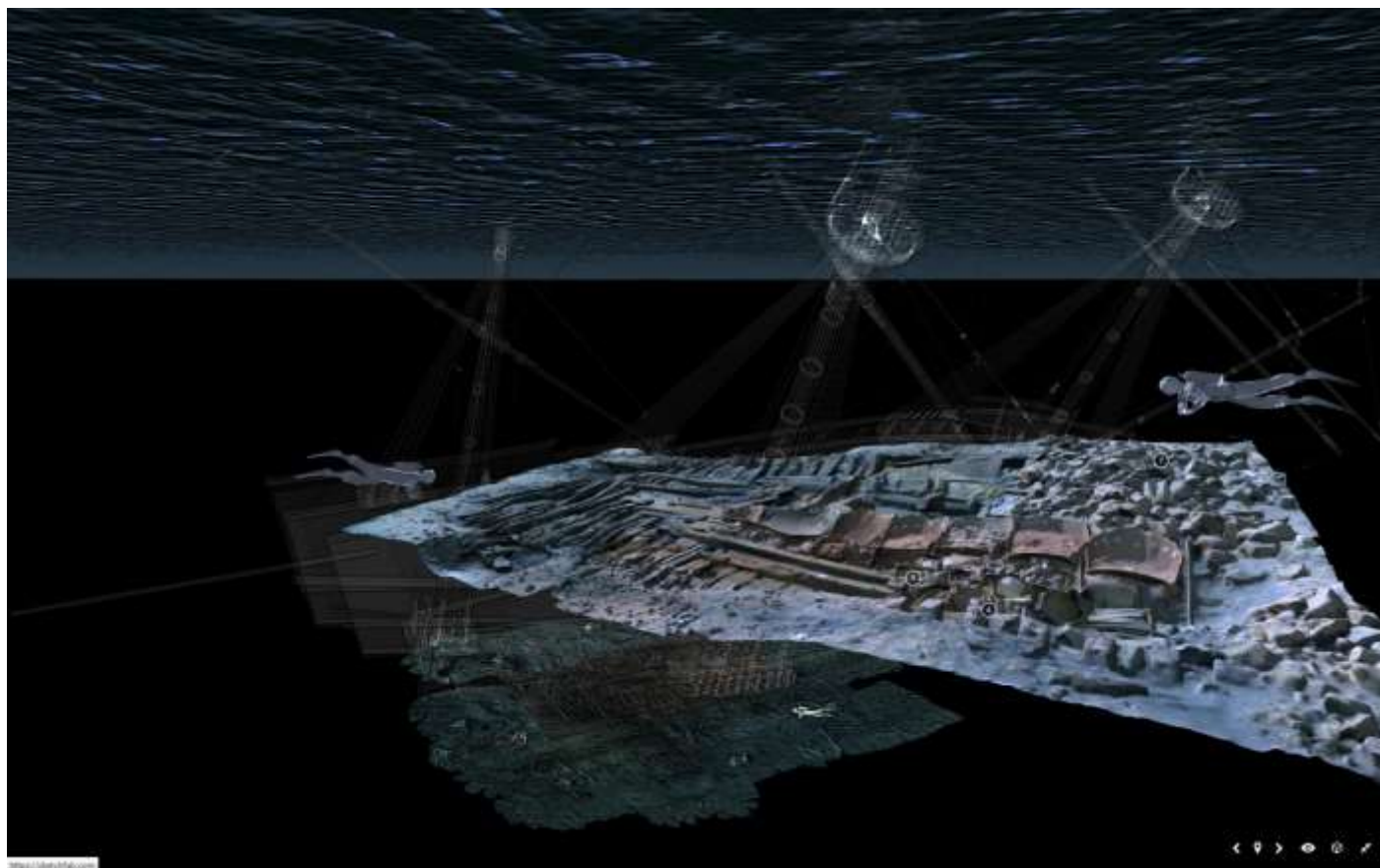
logues. In the present dissertation, the author will analyze and develop methods to use data sets produced by photogrammetric models in the reconstruction of shapes and structures of archaeological ship remains.

The basic structure of the present dissertation follows the methodology workflow developed by the author (Yamafune, Rodrigues and Castro, in preparation), and discusses a methodology to reconstruct lines drawings and hull structures, based on data collected through the workflow. It is organized in two basic parts. The first will focus on techniques and methods used to produce

accurate 3D photogrammetric models, geo-referenced high-resolution photo mosaics, and section profiles. The second part will discuss a meth-



Workflow of the proposed methodology.



SketchFab experiment with the 2014 reconstruction of the Gnalic shipwreck site. Partial images, presenting for instance weekly excavation reports, can be shared on line and tagged, in order to encourage early peer review of each excavation stage, and share all results on line in real time (Kotaro Yamafune).

odology to reconstruct archaeological ship remains.

The workflow proposed in this dissertation was designed to combine Computer Vision photogrammetry and traditional archaeological excavation methods. Although photogrammetric models are primarily used for visualization purposes, the author proposes that they can be used as sources of



Aspect of the 3D image of the stern portion (deadwood) of the Gnalic shipwreck after the 2014 excavation season (Kotaro Yamafune).

accurate archaeological data, and support traditional archaeological work. The major advantage of Computer Vision photogrammetry in underwater excavations is that it simplifies the data acquisition procedure and reduces the recording time. The underwater recording process is tremendously simplified and reduced to the establishment of a basic reference grid and the acquisition of high quality photos with a certain amount of overlap. Photogrammetry minimizes the underwater recording time and maximizes the quality of the data acquired. Furthermore, this process produces extremely versatile digital datasets, which can be migrated and converted into a countless number of formats and stored, organized and processed in order to analyze the site formation process and reconstruct the archaeological remains. The author hopes that the present dissertation shall contribute to the development of maritime and nautical archaeology, serving as a basic guideline for archaeological excavations.

CONCLUDED GRADUATE WORK

Rodrigo Torres

Stranded Shipwrecks of Southern Brazil

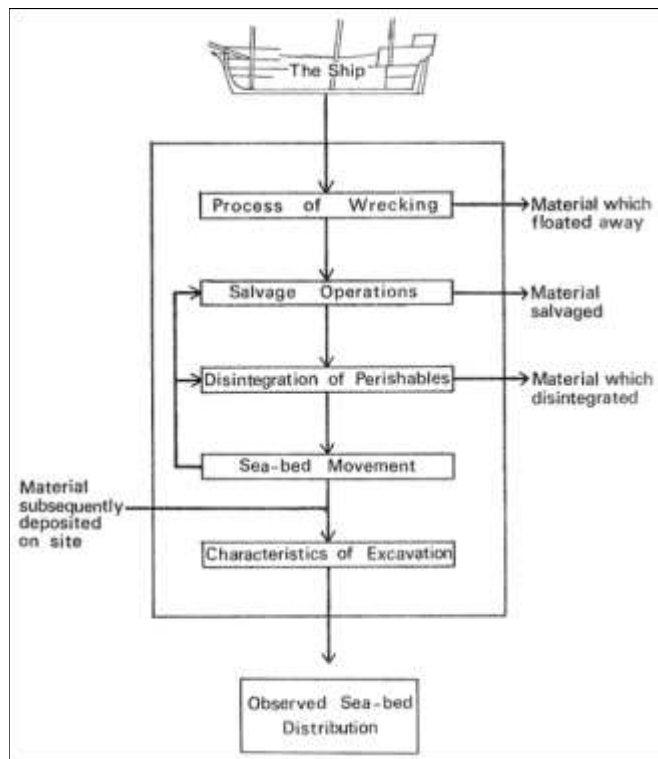
PhD, 2010 - 2015

In the southernmost coast of Brazil, an extensive and scarcely populated sandy shore nearly 400mi long, is home of stranded ships representing various periods of navigation in the southwestern Atlantic (Annex 1). Preliminary investigations suggest a greater occurrence of maritime accidents in the last 200 years, especially in the nineteenth-century, due to the losses of merchant sailing vessels engaged in newly opened trading routes between Europe, North America, Southern Brazil and River Plate provinces.

In fact, the nineteenth-century was an interesting period filled with opportunities for the nations situated along the margins of the Atlantic rim. New political conditions and the liberalization of seaborne commerce early in the century provided conditions for Brazilian port cities to engage Atlantic trading networks. By this time, the Atlantic Ocean was already a well-established commercial and cultural venue, where merchant vessels from various parts of the world transported goods, peoples and ideas along with the development of modern economics. In southern Brazil, the small port city of Rio Grande would hence flourish as an important commercial center of Atlantic South America.

The main goal of this research is to study late modern Atlantic mercantile maritime culture through the archaeological investigation of

stranded shipwrecks found in the intertidal zones of the Rio Grande do Sul seashore, southern Brazil. The shipwrecks were found partially buried in wet and dry sections of the beach. These sections profile an alternation of cyclical (seasonal) and non-cyclical (meteorological) events such as natural flooding, burial and exposure. These events have significant implications for the preservation of the materials studied, for the distribution of the wreck remains and the



Flow diagram showing Muckelroy conceptual model of cultural and natural factors involving the development of a wreck site (After Muckelroy, 1978: 282).

interpretation of archaeological data (Torres, 2012). The methodological approach

will focus on understanding the cultural and natural formation processes behind the occurrence and distribution of the shipwrecks.

Stranded shipwreck sites often occur in highly dynamic sedimentary environments, posing major challenges in terms of preservation and coherence of the archaeological data. Beach environments are among the most energetic and complex depositional systems in the world's oceans (King, 1972; Zenkovich, 1967), where multi-directional wind, waves and currents affect sediment transportation and depositional patterns, as much as it does with artifact distribution on the wreck site. These sites typically consist of widely scattered materials located either in the intertidal zone or above the high-tide line. The literature refers to these sites as 'scattered' or 'scrambled' (see Delgado, 1984, 1985, 1997;



Site 3: NAV Fakir (Rodrigo Torres)



3D site plan (Rodrigo Torres)

McNinch *et al.*, 2006; O'Shea, 2002; Russel, 2002; Muckleroy, 1975).

Understanding the particularities of wreck sites formation has been a focus in the field of shipwreck archaeology since its origins in the 1960's (Dumas, 1962; Bass, 1966). It initially developed around issues of defining wreck sites typologies and discussing the coherence of archaeological record in relation to the physical characteristics of the underwater environment

(Dumas, 1962, 1972; Frost, 1962; Muckelroy, 1977).

Due to the privileged nature of incredibly rich wreck sites off the Mediterranean coast, where

the 'microcosms' of ancient people have been investigated since the 1960's, the sub-discipline of nautical archaeology has mostly been associated with the excavation of well-preserved, near-pristine shipwreck sites (see Bass, 1972; 1983). Early publications have thus somewhat disregarded the signif-

icance of shallow and scattered ship remains, due to their presumed little coherent information content (Dumas, 1962, 1972; Frost, 1962).

The proposed approach to the problem of interpretation of shore stranded shipwrecks in southern Brazil will be delimited by three analytical instances, or contexts: 1) the coherence of structures and artifacts at individual sites; 2) their distribution in space; along the Rio Grande do Sul seashore, as well as in time; and 3) the southwest Atlantic Ocean as a space for the circulation of maritime culture, where the merchant ship and its material culture are part of a macro-regional sphere of circulation of goods, people and ideas during the late Modern period.



Site 1: NAV LG Peixe (Rodrigo Torres)

CONCLUDED GRADUATE WORK

Charles Justus Cook

A Parametric Model of the India Naus

Chair: Frederick Parke, VizLAB

MA, 2010-2011

This interdisciplinary project combined the disciplines of nautical archaeology and computer visualization in order to create an interactive virtual reconstruction of a Portuguese nau. Information about the shipbuilding process was gathered from 16th and 17th century treatises by Fernando Oliveira and João Batista Lavanha . Eight registered tonnage formulas from the 16th and 17th centuries were used to estimate the cargo capacity of the reconstructed hulls. Using this information Justus Cook developed an algorithm that creates a parametric computer model of a hull and calculates its registered tonnage. This parametric model allows the user to choose between the Oliveira and Lavanha conception recipes, adjust the basic dimensions of a ship's hull (e.g. keel length, beam, depth of hold) to fine-tune the hull shape further, and save the information about the hull shape for future editing. The eight registered tonnage estimates are compared to the volume of the parametric hull model below a generic waterline.

Ship shapes are relatively easy to define through a small number of more or less complex curves:

1. The curve defined by the sternpost, keel and stem post;
2. The turn of the bilge curve;
3. The lower whale curve;
4. The sheer line.

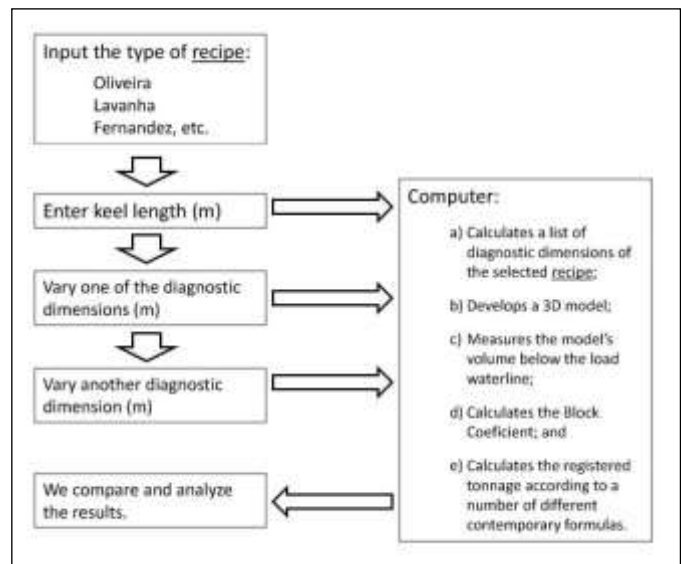
In a significant paper entitled "Shape Creation in Civil and Naval Architecture" (Nowaki and Lefèvre, eds., *Creating Shapes in Civil and Naval Architecture*. Leiden: Brill, 2009: 3-45) Horst Nowaki argues that the evolution of ship shape can be analyzed along three axis:

1. The time axis;
2. The geometric complexity axis;
3. The axis of tools and methods of shape creation.

In this particular study Justus was asked to take in consideration only the axis of geometric complexi-

ty. For the relatively short period under analysis the tools and methods used by shipwrights to generate shapes were limited and common to the entire region considered (Europe).

The shapes under study – the lower hulls of merchant and warships of the sixteenth and early sev-



Proposed workflow .

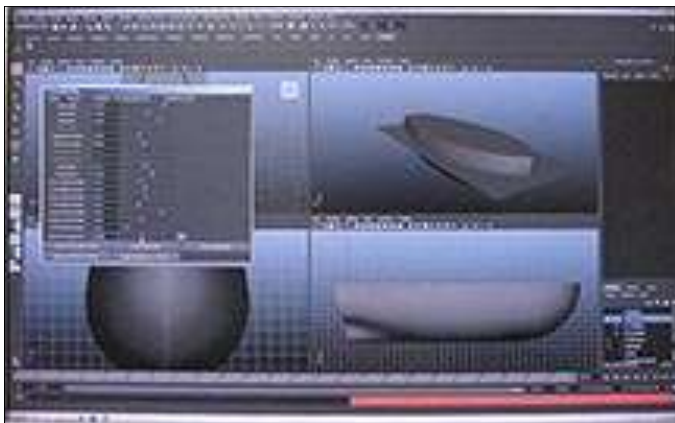


Justus' model was developed in Autodesk Maya. Hull coefficients, displacements and capacities calculated from eight different formulas were computed separately and displayed in a spreadsheet for comparison purposes.

enteenth centuries – are relatively easy to model using differential geometry, namely applying the concept of Gaussian curvature.

One day we expect to use Paul de Casteljaou / Pi  re Bezier's algorithms / curves and explore this subject further, but at this time we focused on a more immediate problem: to indentify and map the knowledge gaps encountered when we try to model three basic hull types: caravels, galleons and *naus*, namely in what pertains to the ranges of variations in length, beam, and depth of hold within each type, and within a period of around 150 years (1500-1650).

Understanding rated capacity and displacement becomes the first step in such a project. Different



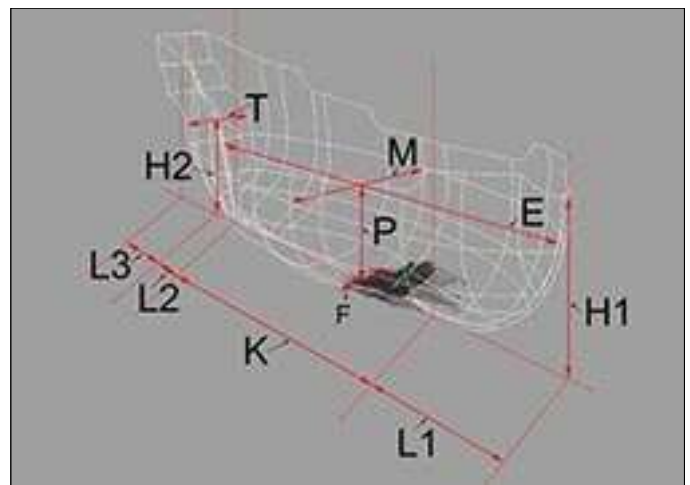
Computer model showing the parameters that could be varied to understand the possible shape variations.

countries rated their vessels in terms of capacity based on different units and methods. After 1530 several formulas were adopted to determine a ship's freight capacity.

There are few studies relating different units, formulas, and functions, in a way that allows meaningful comparisons between, for example, a ship of 300 *tons* in England, circa 1550, and a *nao* of 300 *toneladas* in Spain, in the same year.

We have, however, a rather extensive list of basic dimensions of European oceangoing ships from this period that would be very interesting to compare.

Based on these data, this project followed the steps



Basic measurements defining a ship hull.

indicated on the fluxogram below and tried to understand the ranges of values expected for a number of parameters, such as hull coefficients, displacements, and designated capacities for a small sample of ships for which we have building contracts or other documents mentioning basic dimensions.

The results obtained suggest a fairly predictive set of variations in shape and size throughout the period under study, but only further research will allow us to draw definitive conclusions.

Citation

Cook, C. J., 2011. *A Parametric Model of the India Naus*, MS Thesis, Department of Visualization, Texas A&M University

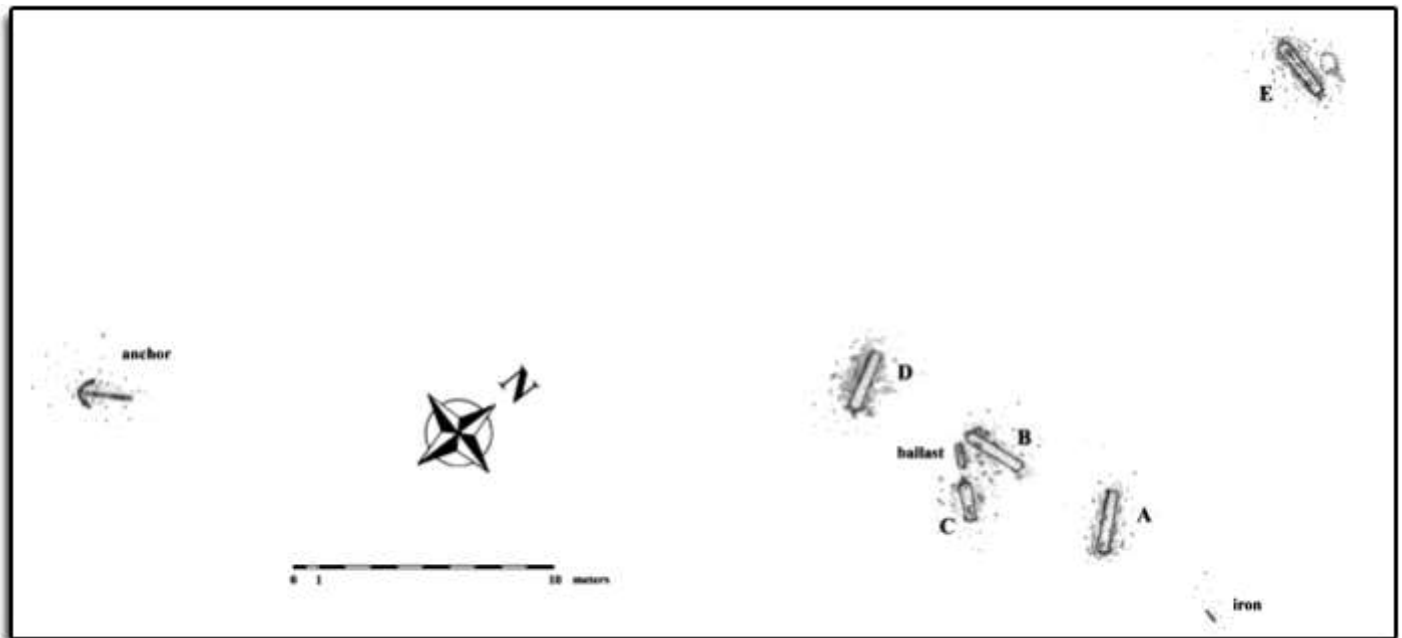
CONCLUDED GRADUATE WORK

Chris Cartellone

The Nevis Project: A Survey of Nevis Island Shipwrecks

PhD, 2009 - 2015

On 25 January 1782, during the Battle of Frigate Bay, HMS Solebay wrecked in shallow waters off the southwest coast of Nevis in the Lesser Antilles. Captain Charles Holmes Everitt scuttled the wreck by detonating 160 barrels of gunpowder to prevent capture to the pursuant French. On 26 March 2010 a team from the Nevis Historical and Conservation Society (NHCS), the Nevis Air and Seaport Authority (NASPA), and Envision Mapping UK Ltd. discovered what appears to be remains of the Solebay shipwreck. In June 2010 Chris Cartellone, PhD student in the Nautical Archaeology Program at Texas A&M University, conducted a pre-disturbance investigation to assess the wreckage and recommend plans for future studies. .



Site plan (Chris Cartellone).

During the closing years of the American Revolutionary War, France attempted to capture the wealthy British-controlled sugar islands of St. Kitts and Nevis. The British responded by sending 22 warships from Antigua, under the command of Rear Admiral Sir Samuel Hood, to meet the 21 French ships.

As Hood's fleet rounded the southern coast of Nevis and sailed north to engage the French, the Eng-

lish frigate *Solebay* ran aground in the shallow waters just offshore. Separated from the line, and under enemy fire, Captain Charles Holmes Everett ordered his crew ashore, and set *Solebay* on fire lest she fall into enemy hands. After burning for an hour, the frigate blew apart due to the 160 barrels of gunpowder aboard. Though they lost the vessel, the British won a tactical victory against the French fleet and succeeded in halting the invasion.



The remnants of this vessel have remained scattered across the ocean floor since its loss in 1782. Discovered in March 2010 by an ad hoc team of Nevisian and international researchers, the author went to the site in 2011 with simple and clear goals: delineate the site, identify materials, affirm or deny the wreck as *Solebay*, and establish a precedent for high quality underwater archaeological investigations on Nevis. It is expected this precedent will allow the author to locate and study other shipwrecks in Nevisian waters, thereby revealing the maritime history of Nevis through underwater archaeology.

While *Solebay* may have been subject to salvaging, metal materials still remain on the seafloor including cannon, carronades, ballast, musket balls, copper tacks and keel staples, and various encrusted artifacts.

To record the artifacts, the author led a research team of faculty, students, and volunteers from multiple institutions for a month this summer. Techniques consisted of scuba diving with direct measurements, bearing-distance relationships, circle searches, photography and video recordings, metal detecting, and use of INA's magnetometer to help locate cannons or ballast in the greater debris field. The team has identified a total of six guns, including two carronades that are both unique in their design.

Publications

Parkoff, J., and Cartellone, C., 2012. "HMS *Solebay* Shipwreck: An 18th-Century British Frigate in Nevis, West Indies." in *CMAC News and Reports* 3.2: 8-10.

CONCLUDED GRADUATE WORK

Kotaro Yamafune

Namban Screens

Namban screens are a well-known Japanese art form that was produced between the end of the 16th century and throughout the 17th century. More than 90 of these screens survive today. They possess substantial historical value because they display scenes of the first European activities in Japan. Among the subjects depicted on Namban screens, some of the most intriguing include ships: the European ships of the Age of Discovery.

Namban screens were created by skillful Japanese traditional painters who had the utmost respect for detail. The scenes depicted in them were long thought to be accurate representations of the arrival of the Portuguese merchant ships that carried out the commerce with this nation. However, as the author has noticed, most of the European ships depicted in these screens are inaccurately represented and strangely anachronistic. Only a small collection of drawings actually looks plausible and thus made from stock images done in the presence of the ships at anchor.

During his research of a large collection of screens, the author discovered a series of depictions of ships that are very similar to those represented on the screens. These are maps from the Age of Discovery, when the knowledge gaps were filled with representations of the peoples, the flora and the fauna of the regions depicted, and sometimes with their ships and boats.

What soon became clear is that the artists that painted the Namban screens had access to these maps after the return of the Tensho Embassy to Europe.



One of the more than 90 Namban screens inventoried. The representation of a Portuguese nau is stylized and highly inaccurate.



Another Namban screen: the ship represented is more plausible, and based on a different stock image.

As it happened in Europe, where most ships in paintings resulted from copies of stock images, it seems that the Portuguese ships are in fact taken from European maps by artists that probably never saw them.

After comparing more than eighty images the author organized the ship representations in the screens chronologically, and established a plausi-



Detail of one the ships in a Namban screen. Although impressionistic, some images are rather accurate and suggest that some of the stock images may have been drawn from the actual ships.

ble origin and a genealogy of each Namban ship.

One particular historical event connected Europe and Japan right before the production of the first Namban screens. This event was the first visit of the Japanese Christian embassy, the Tensho Embassy, to Rome, in 1582. Its journey to Europe and the following visit to the *Taiko*, soon after returning from Europe, provided an opportunity to bring books and charts from Europe. The first effective leader of Japan, Hideyoshi Toyotomi, may have been a trigger for the production of one of the most well-known Japanese artworks, the Namban screens.

Kotaro Yamafune, *The Portuguese Century in Japan and the Namban Screens*. (MA 2009-2012).

Citation

Yamafune, K., 2012. *Portuguese Ships on Japanese Namban Screens*. MA Thesis, Department of Anthropology, Texas A&M University.

CONCLUDED GRADUATE WORK

Kelby Rose

The Reverse Naval Architecture of *Vasa*, a 17th-Century Swedish Warship

On August 10th, 1628 the Swedish warship Vasa set its sails for the first time, in Stockholm harbor. Its construction was personally commissioned by King of Sweden Gustav II Adolf and with its full complement of 64 cannon, the ship was the most powerful weapon in the world. After sailing less than one nautical mile, however, Vasa heeled precariously to port, plunging its lowest open gunports underwater. The massive warship filled with water and sank rapidly.

Research

Vasa remained on the bottom of Stockholm harbor for 333 years, until it was raised nearly intact in 1961. It remains the oldest intact vessel ever recovered. After more than two decades of conservation treatment, *Vasa* went on display in a purpose-built museum in 1990. The hull and its associated artifacts have been the focus of intense archaeological investigations since the time of its raising, yet many fundamental questions remain unanswered about the ship. Kelby Rose's dissertation project seeks to answer one of these questions:

How was the hull of Vasa was designed?

In the early 17th century, the Dutch were famed as the premier shipbuilders in Europe and employed in several countries outside of the Dutch Republic. Two Dutch master shipwrights, Henrik Hybertsson and Henrik Jacobsson, oversaw the design and construction of *Vasa's* hull. Construction features of the hull confirm that the ship was built according to 17th-century North-

ern Dutch methods of naval architecture. This is particularly significant as Dutch shipwrights did not design their vessels on paper prior to construction – instead they designed their vessels by eye. It is certain, however, that a deliberate mental de-

sign method was used, just not committed to paper. Literary and archaeological sources indicate that these methods were guided by a small set of rules of thumb. These rules, however, were frequently broken and do not account for every aspect of a ship's design. The experience and judgment of the shipwright filled in these gaps and allowed for complete design realization. *Vasa* presents archaeologists with an unprecedented opportunity to examine this process for an intact 17th-century vessel.

Using advanced digital 3D modeling technology, this dissertation project is virtually decon-

structing the hull of *Vasa* to recover and analyze the underlying system of logic that explains its design.

This project is an important methodological step



The stem post assembly (Kelby Rose).



The sternpost of Vasa (Kelby Rose).

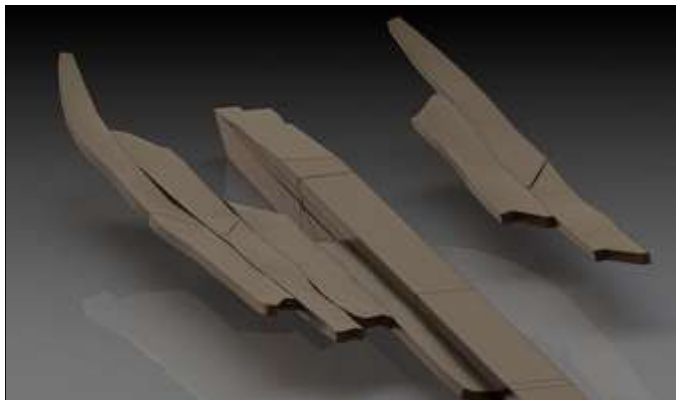
forward for the practice of nautical archaeology. Using *SolidWorks* 3D modeling software, Kelby Rose is constructing precise models of the principal components of *Vasa*'s hull. Due to concerns about its structural integrity, the actual hull of *Vasa* cannot be fully disassembled. The digital models however can be fully manipulated and therefore enable a level of analysis and interpretation that is not possible with their physical counterparts. These models will serve as the basis for a detailed 3-dimensional examination of the naval architectural principles of *Vasa* and recovery of its design

method. This process of recovering the design concept from the intact structure is termed "reverse naval architecture". The highly visual nature of digital 3D models means that both the procedure and results of this project will be documented and disseminated in unparalleled clarity and detail.

The results of this dissertation project will not only answer fundamental questions about *Vasa* and the influential Dutch shipbuilding tradition during the birth of the Scientific Revolution, it will also contribute significantly to the array of analytical and visualization tools available to nautical archaeologists in the 21st century.

Citation

Rose, K., 2014. *The Reverse Naval Architecture of Vasa, a 17th0Century Swedish Warship*. PhD Dissertation, Department of Anthropology, Texas A&M University.



Vasa bottom planking (Kelby Rose)

CONCLUDED GRADUATE WORK

Coral Eginton

Health and Disease on the Dutch High Seas

MA, 2008-2014

This thesis will explore the education, career, and status of ship surgeons employed in the VOC and provide an in-depth analysis of the artifacts recovered from Batavia, Vergulde Draak and Zeewijk that are associated with the surgeon's daily practices. As the ships in question date to the rise and height of Company power in Asia, they provide an excellent snapshot of the surgeon's profession at the busiest and most dangerous periods in VOC shipping.

Excerpts from the thesis:

During the 17th and 18th centuries the Dutch East India Company or *Vereenigde Oost-Indische Compagnie* (henceforth the VOC or the Company) maintained its presence as a power of trade in Asia by establishing footholds and even monopolizing spice markets through its active and successful network of maritime transportation.

Unlike its predecessors in the Indies, the VOC was not interested in colonization so much as pure economic gain. It was understood from the inception of the Company in 1602 that making a profit was dependent upon the safe arrival and return of cargo laden ships, the chances of which could be greatly in-



Mortar found in the *Vergulde Draak* (GT74).

creased by the presence of ship surgeons who worked to keep the crew healthy enough to function. Thus it became company policy to employ ship surgeons on every outbound and homeward vessel and by the end of its two hundred year presence in Asia close to ten thousand surgeons had served aboard ships heading to the Indies.

During the 1970s the Maritime Archaeology Department of the Western Australia Museum conducted full-scale excavations of three VOC ships off the coast of Western Australia.

The artifact collections of *Batavia* (1629), *Vergulde Draak* (1656) and *Zeewijk* (1727) yielded archaeological evidence for the presence of sur-

geons practicing aboard these ships.

Ship surgeons were a unique class of medical practitioner whose profession was significantly different at sea than it was on land. These men acted as



Brass barber's bowls were recovered from the wreck of *Batavia*.

barber, surgeon, and apothecary to crews commonly exceeding two hundred individuals. They faced diseases that had never before been encountered and commonly found themselves treating the casualties of maritime war in addition to treating the daily dietary imbalances and ailments of a standard Early Modern life.

The first goal of this thesis was to identify the equipment used by the surgeons aboard *Batavia*, *Vergulde Draak* and *Zeewijk* in order to fulfill their tri-part role as the ship's barber, surgeon, and apothecary.

The second aim of this thesis was to determine which tools were supplied by the VOC and which instruments the surgeon was expected to provide.

The third goal of this thesis was to examine per-

sonal markings or inscriptions on artifacts and determine if these excluded the possibility of belonging to the Company. While it would generally be believed that sentimental inscriptions would suggest personal ownership, the mortars from *Vergulde Draak* may indicate otherwise.

The fourth goal of this thesis was to investigate whether or not a standardization or shift in quality of Company-supplied equipment could be inferred when comparing the three collections from *Batavia*, *Vergulde Draak* and *Zeewijk*.



Raiser handle found on the shipwreck of the *Zeewijk* (ZW421).

Citation

Eginton, C., 2014. *Health and Disease on the Dutch High Seas: an analysis of Medical supplies from Batavia,, Vergulde Draak, and Zeewijk*. MA Thesis, Department of Anthropology, Texas A&M University.



The Village Barber by Adriane van Ostade (1637)

CONCLUDED GRADUATE WORK

Laura Gongaware

Finding a Middle Ground in the Protection of Underwater Cultural Heritage

MA, 2006-2013

Although cultural heritage located on land receives extensive legal protection in almost every country in the world, cultural heritage located underwater, known as underwater cultural heritage, receives little, if any, protection. For underwater archaeologists, this difference in protection is perplexing because historic shipwrecks, a subcategory of underwater cultural heritage, are unique time capsules.

Excerpts from the thesis:

Whereas most land-based archaeological sites are composed of several settlements built one on top of the other, each historic shipwreck is representative of one moment in history and provides a unique glimpse into ancient maritime trade and transportation. Historic

shipwrecks are also representative of maritime trade and transportation. Therefore, one shipwreck can tell archaeologists more about cross-cultural interactions than several land sites put together. As a result, historic shipwrecks are invaluable underwater cultural resources that deserve to be protected and studied carefully.

Unfortunately, many historic shipwrecks sank car-

rying monetarily valuable cargo and are, therefore, highly sought after by treasure salvors looking to exploit these wrecks commercially. In their search for monetarily valuable cargo, treasure salvors often destroy the nonmonetarily valuable aspects of a historic ship, thus destroying each artifact's provenience .



Michael Hatcher and part of the collection of porcelain salvaged from the Dutch ship Geldermalsen.

The commercial exploitation of underwater cultural heritage is banned under the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Convention on the Protection of the Underwater Cultural Heritage of 2001 (2001 UNESCO Convention).

This ban also prohibits the exhibition of underwater cultural heritage that has been commercially exploited in a state that is party to the 2001 UNESCO Convention. The scope of this ban is



After treasure hunters salvage their shipwrecks, all that is left are auction catalogs.

problematic because commercial exploitation is not defined in the Convention and determining what constitutes commercial exploitation has been more difficult in practice than the drafters of the Convention seem to have anticipated. The prohibition on

the Convention's Annex, which contains two exceptions to the ban.

Chapter 3 and Chapter 4 discuss specific shipwrecks that commercial salvage companies have salvaged. Although the salvage of these wrecks occurred before the Convention entered into force, these wrecks provide interesting case studies because of the recent controversies surrounding either the display of underwater cultural heritage from these wrecks or the potential sale of that underwater cultural heritage.

Chapter 3 looks at the salvage of the Belitung shipwreck, a ninth-century Arabian vessel that sank off the coast of Indonesia, and analyzes whether that salvage violates the Convention's ban on commercial exploitation. Chapter 4 analyzes the salvage of the R.M.S. TITANIC by commercial salvor R.M.S. Titanic, Inc. with a particular focus on article four of the Convention.

Chapter 5 concludes this Thesis, summarizing the current status of the ban on commercial exploitation and what this ban means for commercially exploited underwater cultural heritage.



Catalog of the auction of artifacts of an unique Portuguese shipwreck dating to the 16th century.

the exhibition of commercially exploited underwater cultural heritage can bar academics from studying these valuable resources and prevent the public from enjoying them.

Chapter 2 of this Thesis discusses the specific language of the Convention's ban on commercial exploitation, with a particular focusing on rule 2 of

Citation

Gongaware, L., 2013. *Finding a Middle Ground in the Protection of Underwater Cultural Heritage*. MA Thesis, Department of Anthropology, Texas A&M University.

CONCLUDED GRADUATE WORK

Paul Creasman

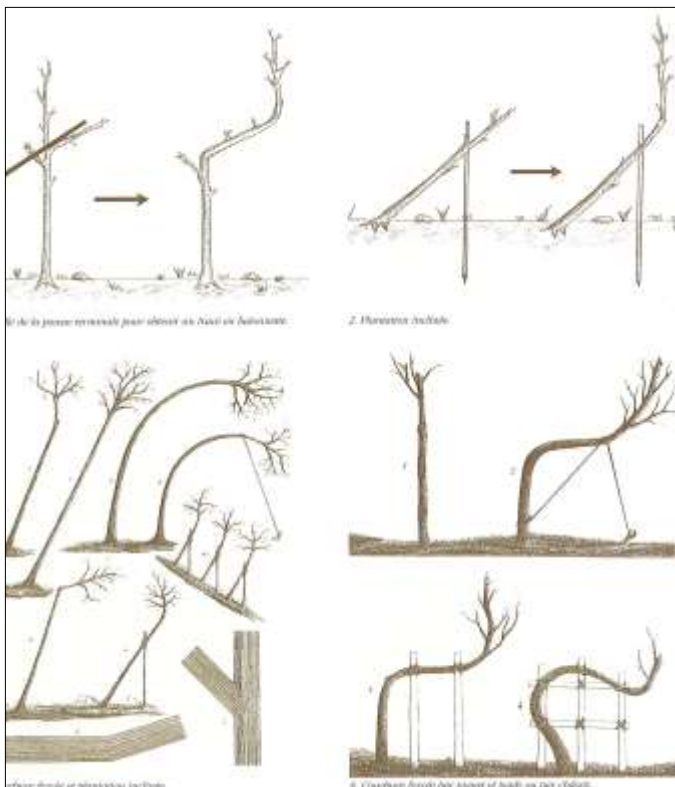
Extracting Cultural Information from Ship Timbers

PhD, 2008-2010

This dissertation is rooted in one general question: what can the wood from ships reveal about the people and cultures who built them? Shipwrecks are only the last chapter of a complex story, and while the last fifty years of nautical archaeology have rewritten a number of these chapters, much of the information unrelated to a ship's final voyage remains a mystery. However, portions of that mystery can be exposed by an examination of the timbers.

Excerpts from the dissertation:

An approach for the cultural investigation of ship timbers is presented and attempts are made to establish the most reliable information possible from the largely unheralded treasures of underwater excavations: timbers.



Tree pruning (Bois de Marine)

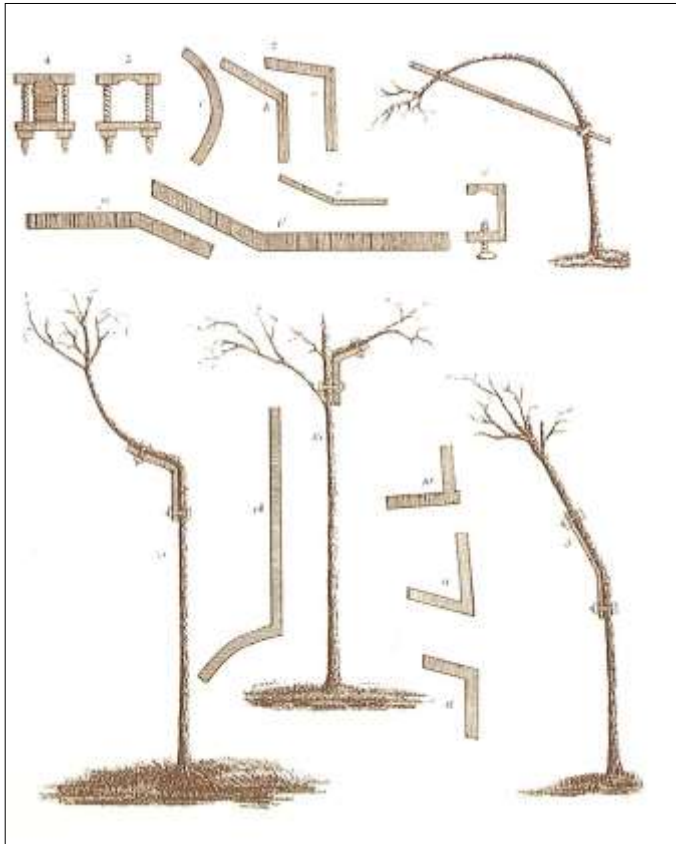
By combining the written record, iconographic record, and the social, economic, and political factors with the archaeological record a more complete analysis of the cultural implications of ship and boat timbers is possible.

I test the effectiveness of the approach in three varied case-studies to demonstrate its limits and usefulness: ancient Egypt's Middle Kingdom, the Mediterranean under Athenian influence, and Portugal and the Iberian Peninsula during the Discoveries. The results of these studies demonstrate how ship timbers can be studied in order to better understand the people who built the vessels.

(...)

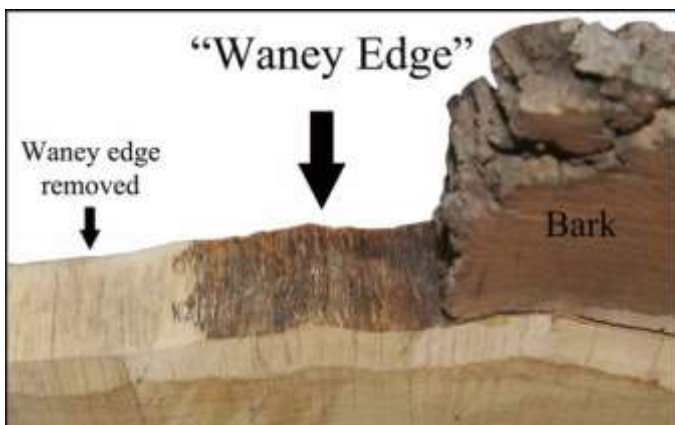
The role that seafaring played in the discovery and conquest of the world should not be underestimated. Whether it was trade and exploration on the Nile River in ancient Egypt that first opened the interior of Africa to the Mediterranean world or the exploits of Spain across the Atlantic to "discover" the New World, there is one common thread: wooden ships and boats.

Any study of the vessels that shaped the world in which we live is incomplete without an understanding of the resources required to construct them: specifically, wood. Since timber has in all ages



Tree pruning (Bois de Marine)

been an important commodity it has been exploited and manipulated. Throughout history, the restrictions of timber reserves have often dictated politics, military tactics, social relations, and economics. Such stresses on resources often caused or contributed to lasting modifications in ship construction, which are visible in the material record today. Not infrequently, these modifications caused or contributed to the demise of the ship itself. In short, maritime prowess is and has always

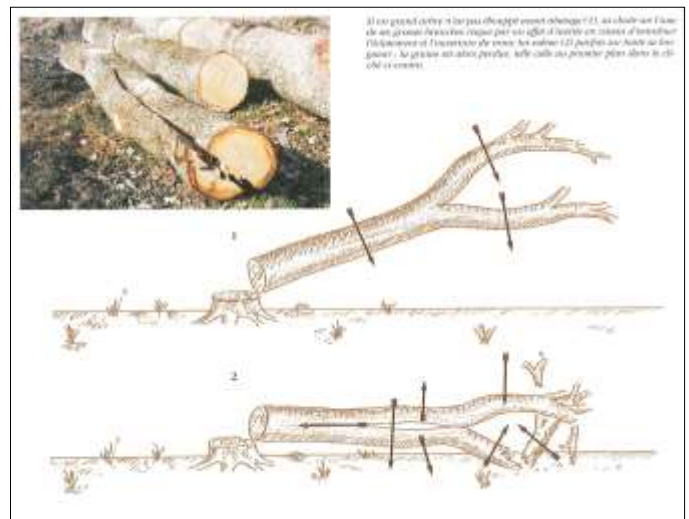


Waney edge and bark (P. Creasman).

been dependent on access to the terrestrial products from which ships are made.

Citation

Creasman, P., 2010. *Extracting Cultural Information from Ship Timbers*. PhD Dissertation, Department of Computer Science, Texas A&M University.



Plan from "Bois de Marine" showing how to fall a tree with two large branches in order not to break it.

CONCLUDED GRADUATE WORK

Lilia Campana

Vettor Fausto (1490-1546)

MA, 2006-2010

This thesis investigates the significant role that the Venetian humanist Vettor Fausto (1490-1546), professor of Greek at the School of Saint Mark, played during the first half of the 16th century in Venetian naval architecture.

From the Abstract:

Early in the 16th century, the maritime power of Venice was seriously threatened by the Ottoman Sultan Suleiman II in the East and by the Holy Roman Emperor Charles V in the West. In order to regain its naval power in the Mediterranean, the Republic of Venice strongly encouraged Venetian shipwrights to submit new designs for war galleys. The undisputed founder and champion of this naval program was not a skilled shipwright but a young professor of Greek in the School of Saint Mark named Vettor Fausto, who in the heat of this renewal programme, proposed “marine architecture” as a new scientia.

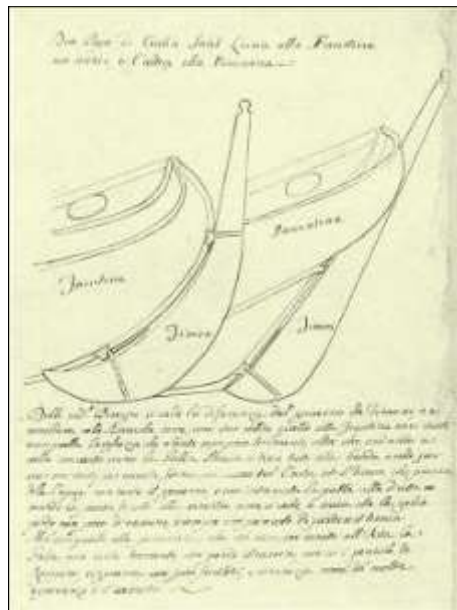
In 1529, Vettor Fausto built a quinqueremis whose design, he claimed, was based upon the quinquereme “used by the Romans during their wars” and that he had derived the shipbuilding proportions “from the most ancient Greek manuscripts.” The recovery of Classical traditions resulted in major changes in many fields. It included shipbuilding practices as well, especially after Fausto introduced in the Venetian Arsenal a new scientia, that of “marine architecture”, in opposition to the fabrilis peritia, the empirical shipbuilding practice.

This work examines several Renaissance sources and archival material in order to illuminate the technical features and the design of Fausto’s quinquereme. Based on the study of the anonymous 16th-century Venetian manuscript *Misure di vascelli etc. di...proto dell’Arsenale di Venetia* from

the State Archive of Venice, this thesis presents a general overview of Fausto’s life and his cultural background in order to better understand the humanistic foundations that led him to propose the construction of the quinquereme. Also presented in this thesis is a theoretical reconstruction of Fausto’s quinquereme and the suggestion that the shipbuilding instructions contained in the anonymous manuscript are connected to the work of Fausto in the Venetian Arsenal.

Vettor Fausto was well ahead of his time; he was able to combine his humanistic theoretical knowledge with shipbuilding practical skills.

No one after Fausto was able to build a galley according to ancient Greek and Roman proportions: his ability as a marina architectura (naval architecture) lived and died with him. Although Fausto represented an isolated figure and an exception among the shipbuilders in the Venetian Arsenal who relied on empirical shipbuilding practices,



Stern rudder “in the Fausto’s way” (left) and “in the Western way” (right).



Aerial view of Venice.

he nevertheless profoundly influenced the history of naval architecture.

In the first decade of the 16th century, Fausto began his studies at the prestigious School of Saint Mark in Venice. In 1509, however, the War of the League of Cambrai drastically changed the situation in the Republic of Venice, and the School temporarily closed its doors during the war. Fausto then undertook a six-year-long journey that brought him to other Italian maritime cities, Spain, and France. Upon his return to Venice he wished to place his newly gained knowledge at the service of the Serenissima, the Most Serene Republic of Venice. In 1518, Fausto was appointed professor

of Greek at the School of Saint Mark, which had opened its doors after the termination of the war in 1511. In 1526, Fausto proposed to the Venetian Senate the construction of a new, superior type of galley he called the quinquere, the proportions of which he based on his knowledge of ancient Greek and Roman ships. With some skepticism, the Senators approved the proposal, and in 1529, Fausto launched his quinquere in the Grand Canal, where the ship won a race against a light galley.

Citation

Lilia Campana, 2010. *Vettor Fausto (1490-1546), Professor of Greek and a Naval Architect: a New Light on the 16th-Century Manuscript Misure di Vascelli etc. di...Proto dell'Arsenale di Venetia*. MA Thesis, Department of Anthropology, Texas A&M University.



Galleass "in the Fausto's way" (alla Faustina). Steffano de Zuanne, *Architettura navale*, 1686.

CONCLUDED GRADUATE WORK

Carlos Monroy

Nautical Archaeology Digital Library

PhD, 2005-2008 - Chair Richard Furuta

NSF Grant IIS-0534314

The objective of this project was to design, implement, and evaluate a framework that would a) efficiently catalog, store, and manage artifacts and ship remains along with its associated data and information produced by an underwater archeological excavation; b) integrate heterogeneous data sources from different media to facilitate research work; c) incorporate historic sources to help with the study of current artifacts, d) develop visualization tools to help researchers manipulate, observe, study, and analyze artifacts and their relationships; and e) develop algorithm and visualization based mechanisms for ship reconstruction, i.e. to determine where recovered pieces and fragments fit in a whole. Our objective was to make the findings and information acquired available over the Internet to scholars as well as to the gen-

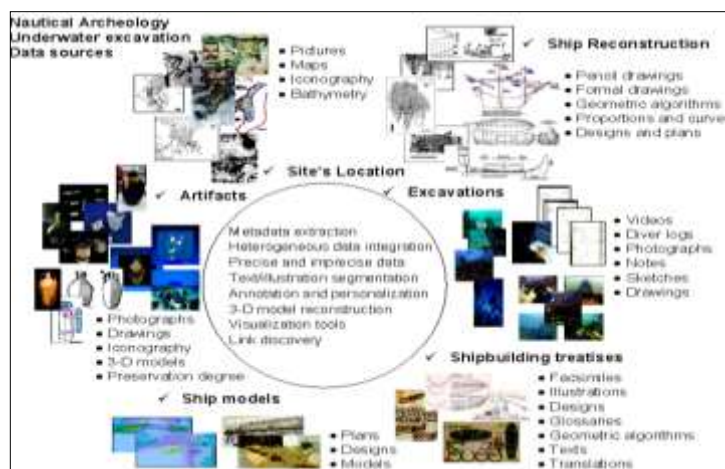
Introduction

From the Computer Science viewpoint, the major impact areas of this project were within the specialty area of Digital Libraries and included:

- A flexible cross-linking of heterogeneous content in a dynamically-growing collection;
- A flexible use of annotations to enhance community access while respecting individual information rights;
- A focus on incorporating uncertain data;
- Advances in the digital library replication and synchronization; and
- General applications of visualizations based on 2D grids.

From the Nautical Archaeology viewpoint, the major impacts of the project were:

- Developing a model for mapping an underwater archeological excavation site:
- Establishing a protocol for storing, managing, and organizing information related to a shipwreck:
- Creating a framework to enable the integration of heterogeneous data sources and media:
- Developing new ways for structuring and accessing ancient shipbuilding treatises; and
- Providing computational assistance for the identification and placement of ship fragments to allow ship reconstruction.



Ship Ontology

Throughout the ages countless shipwrecks have left behind a rich historical and technological legacy. Nautical archaeologists study the remains of boats and ships, and the cultures that created and used them. Ship reconstruction can be seen as an incomplete jigsaw reconstruction puzzle. In this project Carlos Monroy hypothesized that a computational approach based on digital libraries can enhance the reconstruction of a composite object (ship) from fragmented, incomplete, and damaged pieces (timbers and ship remains).

The main archaeological sources used in this project were data generated from a 17th-century Portuguese ship, the *Pepper Wreck*, complemented with information obtained from other documented and studied shipwrecks. Shipbuilding treatises spanning from the late 16th- to the 19th-centuries provided textual sources along with various illustrations. Additional visual materials came from a repository of photographs and drawings documenting numerous underwater excavations and surveys.

An ontology was developed, based on a rich database of archaeological information compiled by the late J. Richard Steffy, creator of the ShipLAB and one of the founders of the Nautical Archaeology Program. The original database was analyzed and transformed into an ontological representation in RDF-OWL (?). Its creation followed an iterative methodology which included numerous revisions by nautical archaeologists. Although this ontology does not pretend to be a final version, it provides a robust conceptualization.

An important component of the architecture of this project was an ontology for describing wooden ships, called *ontoShipDS*. This ontology is contained in an RDF-OWL formatted file. It was created using Protégé [Protégé 2000], an open source ontology editor.

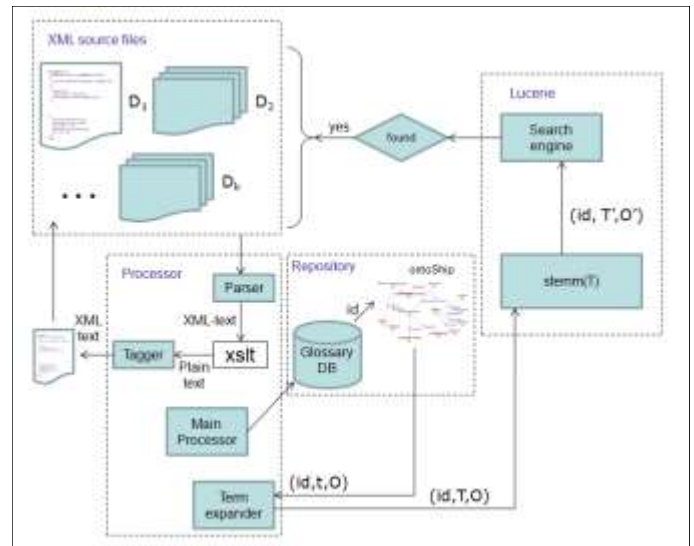


Diagram depicting the system architecture of the framework proposed in Carlos Monroy's this dissertation.

Navigation through the ontology is possible with a web-based ontology browser. This browser is open source software provided in collaboration between the Universities of Manchester and Stanford [Ontology Browser 2009].

Publications

See pages 22-23.

Citation

Monroy, C., 2008. *A Digital Library Approach in the Reconstruction of Ancient Sunken Ships*. PhD Dissertation, Department of Computer Science, Texas A&M University.

CONCLUDED GRADUATE WORK

Audrey Wells

Modeling the Pepper Wreck

Chair: Frederick Parke, VizLAB

MA, 2004-2008

This study was a collaborative project between the fields of nautical archaeology and computer visualization. An interactive virtual reconstruction of the 1606 Portuguese vessel Nossa Senhora dos Mártires, also known as the Pepper Wreck, was developed as a detailed 3D computer model based upon reconstruction information gathered from the shipwreck site and a number of contemporary texts and images. The model of the ship was displayed within an appropriate virtual environment. Models of cargo and people were added to show how the ship might have appeared loaded with trade goods and hundreds of crew and passengers on the return voyage from India. The scene was shaded and lighted. Both the inter-

Introduction

In Audrey's own words: "Modeling is a very powerful tool, which can allow viewers to progress from what is observable, archaeological data and theory, to concepts of what is unobservable, the past."

Quoting Gary Lock's *Using Computers in Archaeology: Towards Virtual Pasts* (London: Routledge, 2003), Audrey continues: "Moving from data to explanation through theory and interpretation has always been the endeavor of archaeology."

Lock also presents the use of computer modeling in archaeology as a *hermeneutic spiral*, or process

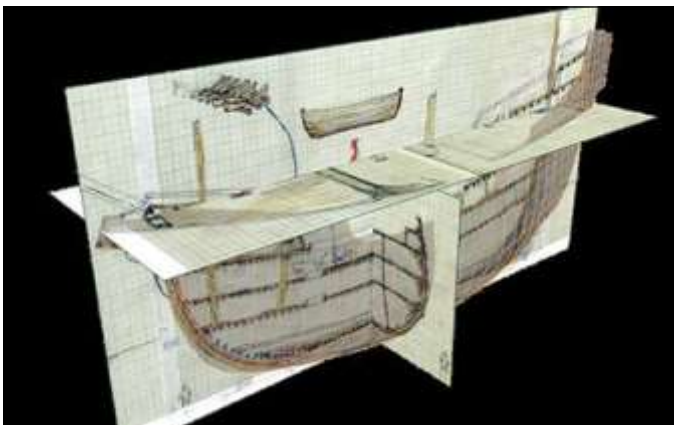
of interpretation, in which the data model and theoretical model are derived from the archaeological record through interpretation. Digital computer models, informed by the data and theory, add an additional layer of interpretation.

Based on the models, interpretive statements about the past are made. These interpretations constantly inform and reform our understanding of the past. (...) This is useful because the subject of study is generally from partial remains. Models, and the process to create them, can have a significant influence on archaeological interpretations. Gary Lock asserts: 'Because the past is complex, often unknowable and unverifiable, working through models is the only way of approaching explanation and experimenting with the meaning of observed data.'"

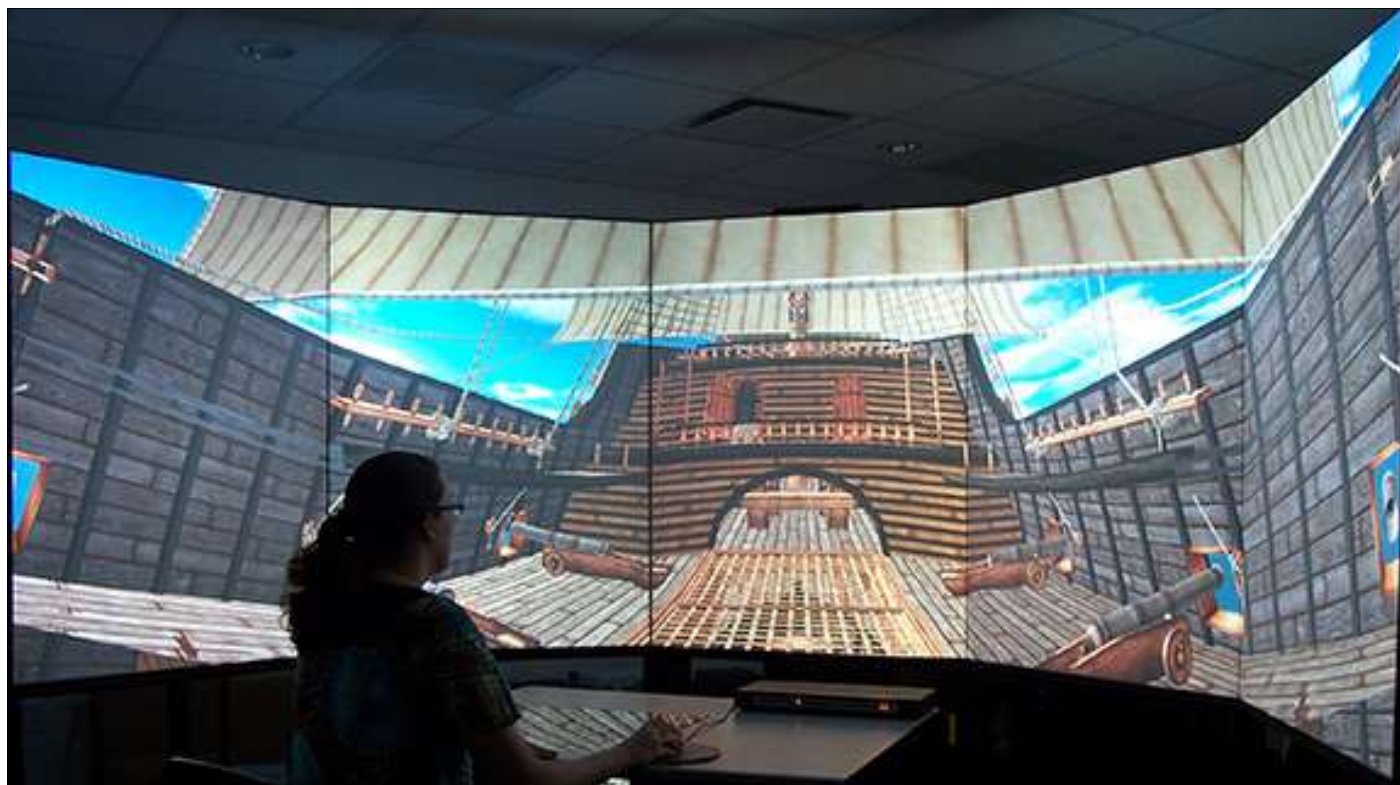
Audrey's model is the basis for further work, namely Kotaro Yamafune's dissertation, which was inspired by it.

Citation

Wells, A., 2008. *A Virtual Reconstruction of a 17th-Century Portuguese nau*. MS Thesis, Department of Visualization, Texas A&M University.



Audrey Wells preliminary study for the Pepper Wreck Model.



Testing the model at Frederick Park's C.A.V.E.



Crew and passengers were modeled after Italian 16th Century painter Luca Cambiaso, whose stylized figures revealed themselves extremely economic in term of computer memory allocated per person.



Reconstruction of the mainmast top, stay, shrouds, and lifts.



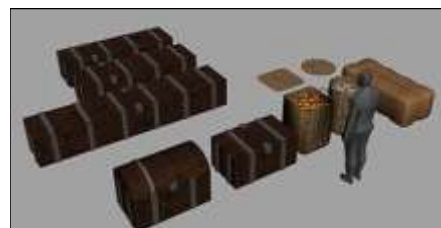
The Pepper Wreck reconstructed and loaded, at departure from Cochin, India, to Lisbon, Portugal.



Asian pots, common in shipwrecks from this period.



Barrels turned up to be very difficult to model, at least in what pertains to their standardized sizes. We have their capacities, but not their main dimensions..



The cargo was object of careful study and all clues to standardization retrieved from coeval documents were used.

CONCLUDED GRADUATE WORK

Bryanna DuBard

The Key to all the Indies: Defense of the Isthmus of Panama

MA, 2005-2013

Beginning in the 16th century, the Isthmus of Panama was identified as a region of strategic importance. Although mountainous and prone to adverse weather, it provided the most direct route between the Atlantic and Pacific oceans. During this period the Isthmus served as the primary route for the shipments of silver and gold extracted from the mines of Peru.

From the Abstract:

The bullion was transported via coastal armadas from Peru to Panamá la Vieja, where it was loaded onto pack mules and hauled across the Isthmus to Nombre de Dios until 1597, and after that to Portobelo.

Once the bullion arrived at the Caribbean port cities it was transferred to the ships of the Armada de la Guardia de la Carrera de Indias and shipped across the Atlantic to the royal coffers of Spain. Because of the Isthmus's role in the transportation of valuable commodities, it quickly became a region prone to attacks by pirates and privateers looking to profit from the plunder of Spanish assets. Thus the Spanish crown began a campaign to defend the Isthmus early on and repeatedly adapted its defensive strategy in order to meet the ever-changing tactics of the pirates and privateers.

This thesis investigates the history of the Isthmus of Panama and the ways in which Spain defended this strategically significant locale during the 16th

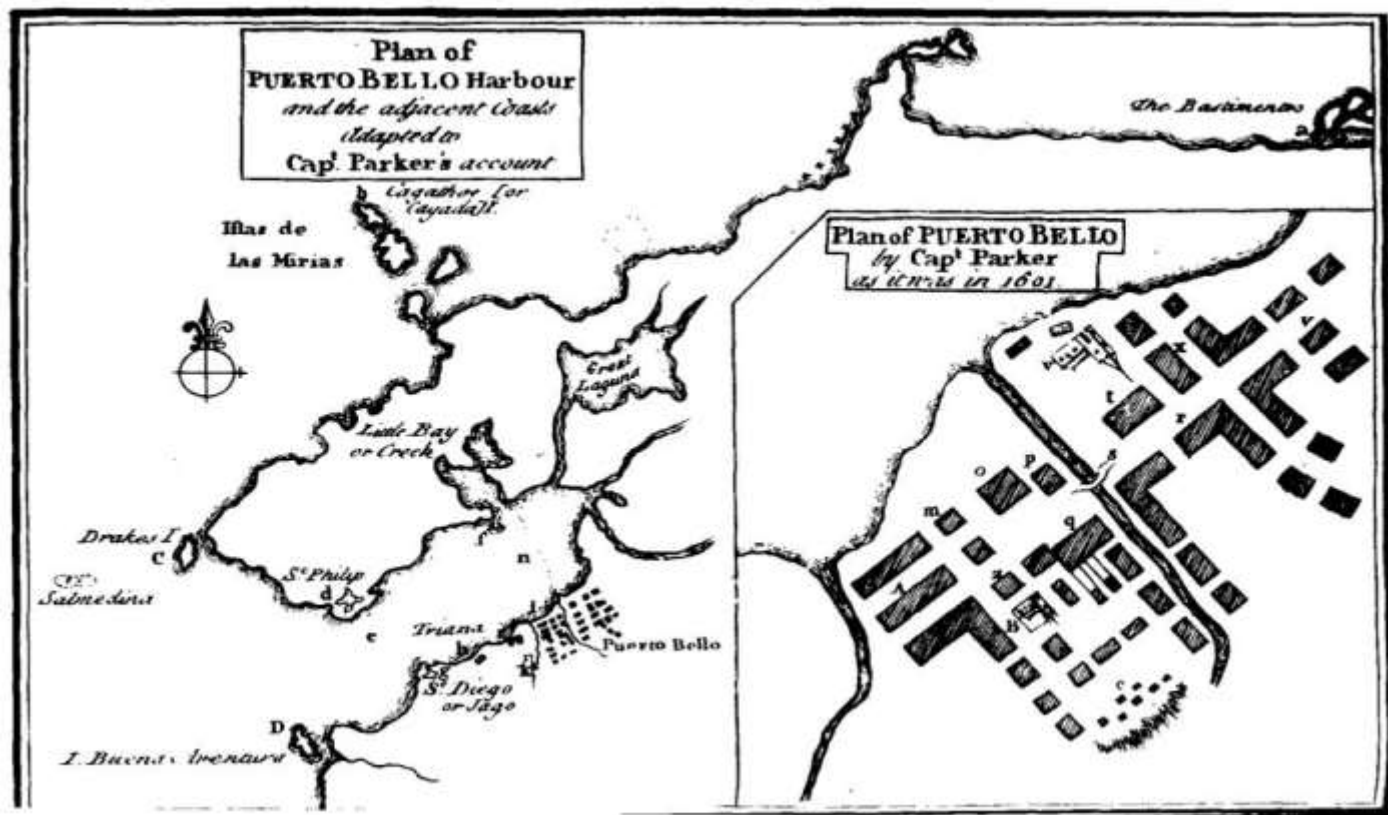
century. It incorporates an historical analysis of the tactics planned, ordered, and executed by the crown; an overview of the most relevant structural remains of the fortifications built during this period; and a synopsis of previous archaeological investigations, as well as the prospects of future archaeological research.

The thesis begins with a brief history of the three main cities located on the Isthmus as well as a general description of the geography and climate in order to better explain the challenges faced by the inhabitants, soldiers, and attackers in this region. It then discusses the strategic importance of the Isthmus as it was perceived in the 16th century. Since defense would not have been necessary had it not been for the presence of pirates and privateers, the history of attacks on the Isthmus is discussed, and a general overview

of piracy in the Spanish Main during the period under analysis is presented. Lastly, the archaeologi-



Plan of Fuerte San Felipe de Sotomayor, 1599 (from Spain, Ministry of Culture, Archivo General de Indias, Mapas y Planos, Panamá, 13).



Plan of Portobelo drawn circa 1602 (from Gardner 1741:84-85). Note the shape of the harbor and the location of the fortifications of Forte San Felipe and Castillo de Santiago at its entrance.

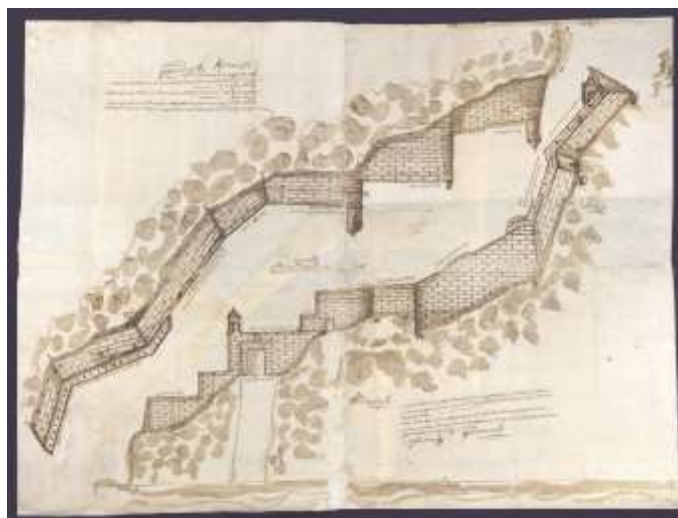
cal work previously undertaken in the region is examined and summarized, and recommendations for further research are provided in an effort to provide a basis for future study of the ships and infrastructure used during this era for the defense of the Isthmus of Panama.

Citation

DuBard, B., 2013. *The Key to all the Indies: Defense of the Isthmus of Panama*. MA Thesis, Department of Anthropology, Texas A&M University.



Plan of the city and port of Portobelo, after Spain, Ministry of Culture, Archivo General de Indias, Mapas y Planos, Panamá, 17



The profile of Forte San Felipe de Sotomayor, 1600 (from Spain, Ministry of Culture, Archivo General de Indias, Mapas y Planos, Panamá, 16).

CONCLUDED GRADUATE WORK

Courtney Higgins

The Venetian Galley of Flanders

MA, 2005-2012

Nautical archaeologists and scholars are often trying to recreate how ships were built and maneuvered. Often due to the delicate nature of older wooden vessels, there is little archaeological evidence remaining to aid in these studies and often they must rely on supplementing what little they have with other resources, such as texts. By using computer programs to process and enhance the information in the texts, scholars can better understand the vessel and explore problems that even hull remains may not be able to address.

From the Abstract:

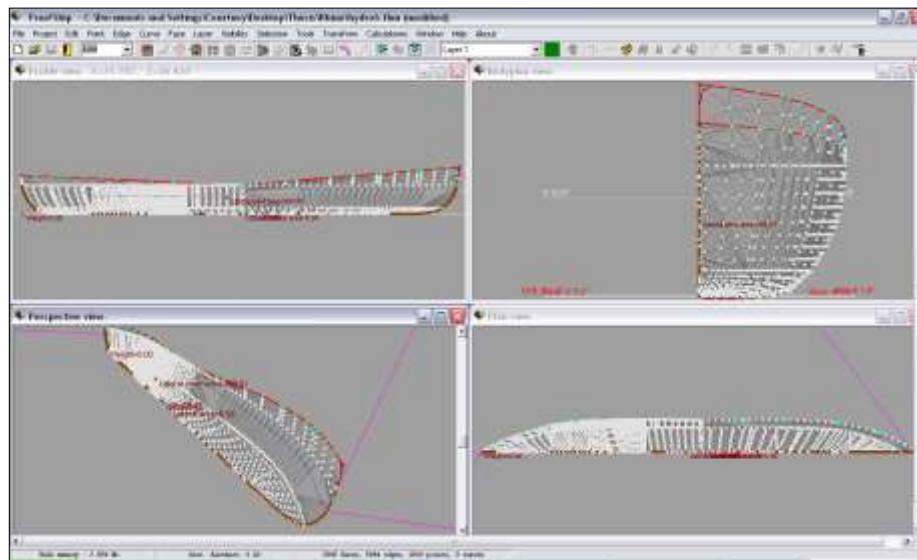
During the High to Late Middle Ages, Venice was a key city for trade and commerce. Their location on the Adriatic Sea helped in linking them from mainland Europe to the Mediterranean Sea. Since its founding, Venice's has been connected to the sea, leading to a long history of shipbuilding. By the Middle Ages, Venice had established several trade routes throughout the Mediterranean Sea and one to the North Sea, specifically to Flanders.

Presently, there is no archaeological evidence of this vessel; however, the merchant galley was written about in several treatises. Three treatises dating to the Late Middle Ages discuss the dimensions the galley, The Michael of Rhodes book, the *Fabrica di Galere* and Libro di

Zorzi Trombetta da Modon.

While the first two were found to be identical copies, they contained enough information to reconstruct a 3-dimensional model of the vessel's hull in the Rhinoceros® software program. From the model, the vessel is then be analyzed for volumetric

information in order to better understand the hull capacity and ideally, how the ship was laden.

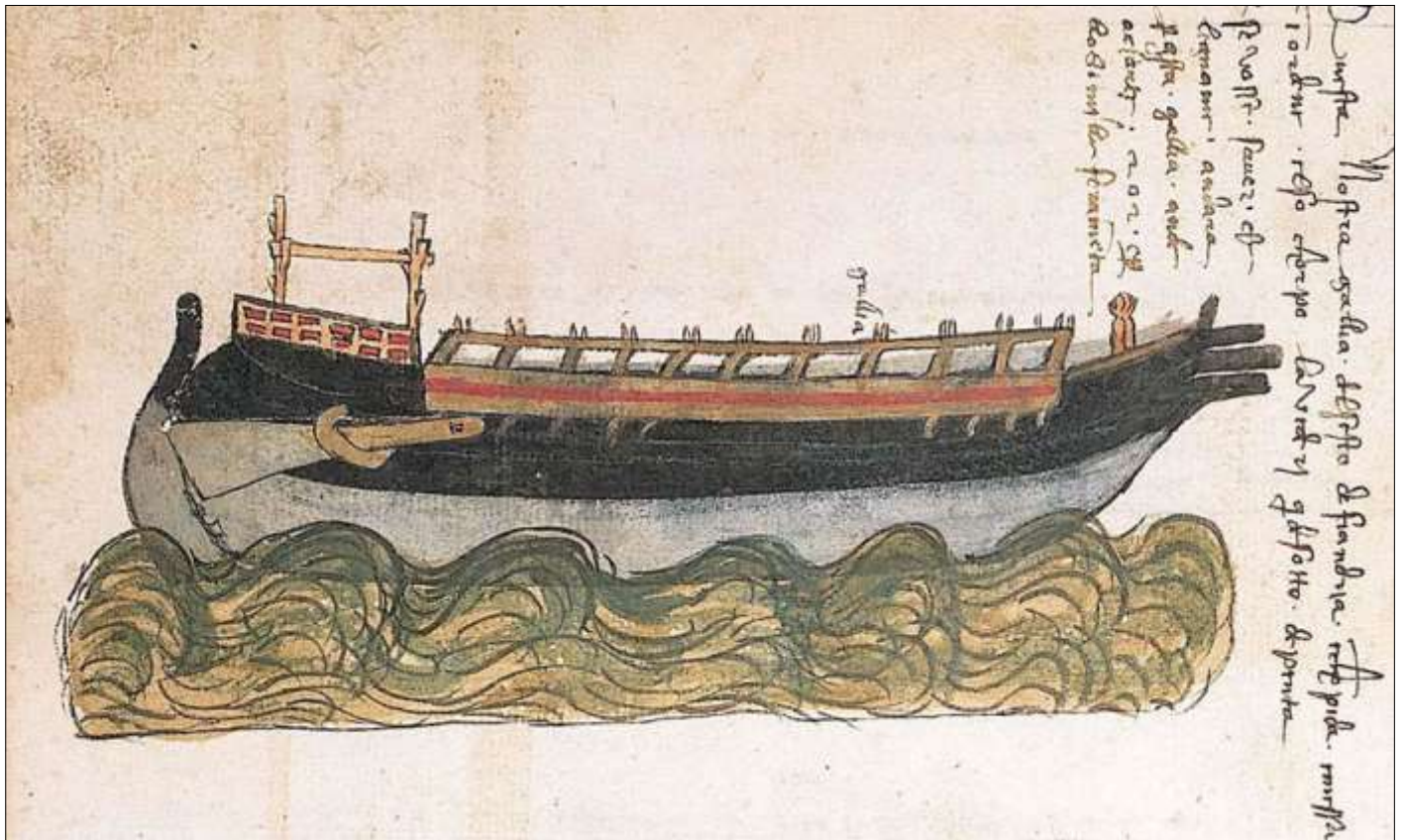


Modeling a Flanders Galley (Courtney Higgins).

From the Conclusions:

This case study only touched on one aspect of using shipbuilding in conjunction

with 3-D modeling. Besides calculating the cargo capacity, the modeling programs can help with understanding other shipbuilding questions, including how a the rowers are positioned, how it would maneuver in different weather or sea conditions, and



Galley in the book of Michael of Rhodes.

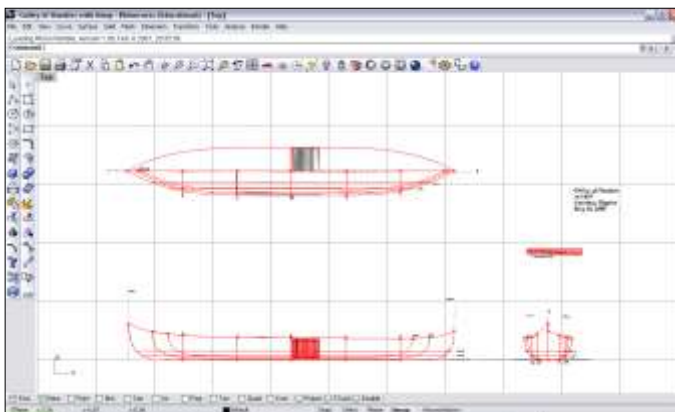
how changing minor building techniques could impact the vessel's capability. These are just a few examples because while programs develop and scholars generate more questions to be answered, the possibilities become limitless.

Shipbuilding treatises are a valuable tool in helping to understand how ships were built and maneuvered, provided one is cautious when using them. The conversion of the galley of Flanders's dimensions from the Michael of Rhodes book into a 3-D

model was a sample of the potential use of treatises and 3-D modeling programs. They can provide a better understanding of vessels where archaeological evidence is sparse. In addition, looking at the capacity is also just the beginning as these tools can help shed light on how the vessels maneuvered, reacted to environmental conditions, and possibly, how they sank. At the height of their trade empire's success, Venice likely saw the potential for overseas trade as limitless, and today with every new resource becoming available, nautical scholars should see the potential in studying the Venetian's vessels also as limitless.

Citation

Higgins, C., 2012. *The Venetian Galley of Flanders: From Medieval 2-Dimensional Treatise to 21st Century 3-Dimensional Model*. MA Thesis, Department of Anthropology, Texas A&M University.



Modeling a Flanders Galley (Courtney Higgins).

CONCLUDED GRADUATE WORK

Vincent Valenti

Reconstruction of the Nave Quadra of the Michael of Rhodes Manuscript

MA, 2005-2009

The subject of shipbuilding in the Mediterranean during the Middle Ages is an integral aspect of the maritime history of this region. Characterized primarily by a fundamental shift in shipbuilding techniques, this phase also included significant developments in other seafaring practices. Yet, unlike the preceding Byzantine era, there is a very limited body of archaeological evidence available for study which can be utilized to illustrate these changes.

From the Abstract:

Therefore, one must turn to alternative sources of information regarding the construction of ships in the Mediterranean, such as iconography and literary evidence.

Perhaps the most informative and useful example of the latter is the group of nautically-themed treatises and manuscripts composed between the 14th and 16th centuries.

The earliest of these to describe ship construction in any detail is the 1434 manuscript of Michael of Rhodes, which will serve as the main subject of study for this thesis.

The primary purpose of this research is to propose a reconstruction of the nave quadra described in the manuscript, though this will be preceded by explanations of several topics pertinent to ship construction in the Mediterranean during the Middle Ages.

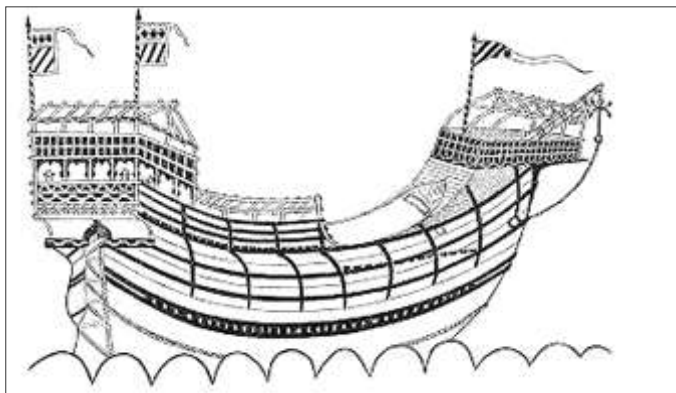
The discussion of such fundamental issues, like the transition from shell-based to frame-based construction and the concept of recording and conveying these processes in a didactic manner, is essential in providing a basis for this study.

Once this foundation has been established, it will then be possible to present the reconstruction of the

nave quadra of the Michael of Rhodes manuscript. With this background information laid out, the significance of both the manuscript and the *nave quadra* in the broader context of medieval seafaring in the Mediterranean should be discernable.



Michael of Rhodes' round ship.



Zorzi Trombetta's round ship.

In addition to the proposed reconstruction, this task of elucidating key aspects such as the transition from one construction technique to another and the compilation of written material on this subject will be essential to providing as comprehensive a picture of medieval seafaring in the Mediterranean as possible.



Round ship by master WA.

From Chapter 1:

From the perspective of the development of ship-building methods in the Mediterranean, the period of time encompassed by the Middle Ages is arguably the most significant era in maritime history. Beginning towards the close of the Roman era, the traditional techniques for the construction of vessels of all types were undergoing a transition towards a more advanced shipbuilding methodology, creating the foundation for the heydays of the sailing vessel and the Age of Discovery that would follow.



Round ship by Botticelli, 1481-1482.

Integral to this evolution was a fundamental shift in the conception and execution of a ship's hull, personified by the gradual abandonment of the traditionally Mediterranean shell-first technique in favor of the principals of the frame-first method. Though originally characterized as such, this occurrence was by no means as linear and neat as initially thought. This notion has become increasingly obfuscated and complicated as the field of nautical archaeology makes ever greater and more profound contributions to the understanding of this period.

Citation

Valenti, V., 2009. *Transitions in Medieval Mediterranean Shipbuilding: A Reconstruction of the Nave Quadra of the Michael of Rhodes Manuscript*. MA Thesis, Department of Anthropology, Texas A&M University.

CONCLUDED GRADUATE WORK

Sarah Kampbell

The Pantano Longarini Shipwreck: A Reanalysis.

MA, 2004-2007

A late antique shipwreck was excavated in the Pantano Longarini marsh in the southeastern corner of Sicily in the 1960s. Despite its excellent preservation, problematic circumstances surrounding its excavation and publication have resulted in scholars ignoring or misinterpreting it. The majority of the data, including original field notes and documentation, are lost, and the drawings, plans, and photographs that remain are sometimes inconsistent and incomplete. My research reanalyzes the remains of this ship to determine how the Sicilians adapted to their marine and economic conditions within the turbulent socio-economic and political climate of late antiquity.



Disassembling the shipwreck in the 1960s.

From the Abstract:

The Pantano Longarini shipwreck demonstrates early stages in a shift from the tradition of plank-based construction to the modern system of reliance on an internal framework for structural support. Contemporary wrecks provide parallels, but unique elements distinguish this ship from those typically studied. Extremely thick timbers, a relatively flat bottom and bow and stern ramps argue that the Pantano Longarini ship was designed to carry bulk loads. Although the ship was originally reported as an extremely advanced ship, the present analysis points to a different type of watercraft: a coastal barge. Correctly identifying the Pantano Longarini ship allows us to gather information about the needs of its builders, as well as

extends our knowledge of shipping and ship construction in the seventh century.

From Chapter IV:

The Pantano Longarini wreck has been widely accepted as an early seventh century vessel. It was originally radiocarbon dated to C.E. 500 \pm 150 (uncalibrated) by H. Schwabedissen for Wilms-Posen in the 1960s. Experts identified sherds found under frames as late Roman or early Byzantine combed-ware amphoras similar to those found on Yassiada A. The excavators claimed that the



The shipwreck excavation.



The shipwreck excavation.

similarity of the construction method to the latter vessel was the most convincing dating evidence. Therefore, Throckmorton and Kapitän chose a date in the early seventh century, towards the end of the established 14C range.

Construction Methods

Dating shipwrecks by their construction is now known to be extremely unreliable due to the non-linear transition in methods across the Mediterranean from the fourth through eleventh centuries C.E. While certain features found on the Pantano Longarini ship do match the Yassiada A ship construction, other features match earlier and later shipwrecks, making it difficult to understand which elements are important for dating purposes. J. Richard Steffy notes that ships may never give as reliable a date as pottery and coins due to the complexity and variation in ships. Furthermore, the chronology of the mortise-and-tenon joint transition is not

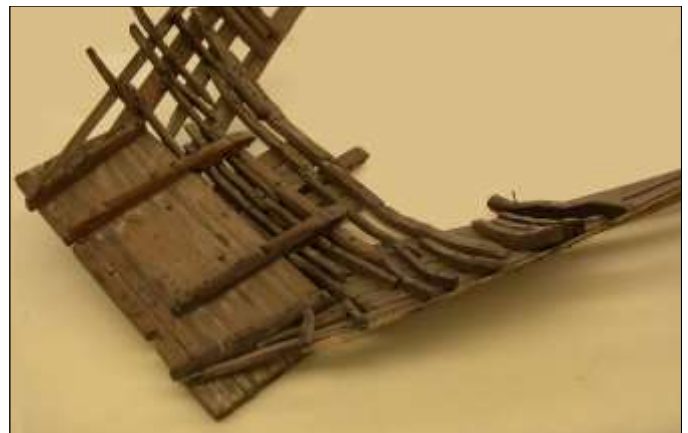
sufficiently understood to firmly date a shipwreck. We do know the transition away from these joints had already begun with



The shipwreck excavation.

the less frequent and looser joints evident in the fourth century Yassiada wreck, and this pattern continued into the 11th century.

Comparing elements other than the construction technique is just as unreliable. The Yassiada A and Pantano Longarini ships do share certain transitional elements such as split half logs for internal stringers and wales in addition to mortise-and-tenon joints used to the first waterline wale. Earlier hulls, such as that found at Cefalù off the northern coast of Sicily, and dating to the fifth or sixth century C.E., had roughly finished frames¹⁷² like those on the Pantano Longarini ship.¹⁷³ Although it was not fully excavated, the Anse Saint Gervais B wreck, dated to the early seventh century, on the other hand, has shown evidence that suggests a more advanced transitional form, with caulking between the hull planks and few mortise-and-tenon joints, save at the extremities.¹⁷⁴ If construction features are to be used for dating, these points must also be considered. The variation in construction



Model by Peter Throckmorton.

method and timber choice demonstrates the complexity of the dating issue.

Citation

Kampbell, S., 2007. *The Pantano Longarini Shipwreck: A Reanalysis*. MA Thesis, Department of Anthropology, Texas A&M University.

CONCLUDED GRADUATE WORK

Hiroaki Myiashita

Ancient Ships of Japan

MA, 2004-2006

Ancient ships of Japan are little known outside of the country. They were the object of this study, presented based on the studies of past researchers, together with a comprehensive analysis of their archaeological remains. The process of development from logboats to extended logboats and finally to assembled craft was traced. This study covered evidence from the Early Jomon period (4000 – 3000 B.C.E.) through the Kofun period (300 – 700 C.E.). A large number of logboat remains date to the Jomon period, and it is these logboats which become the foundation of later Japanese ships. The number of ship remains from the Yayoi period diminishes. Therefore, iconographic evidence, mainly clay ship figures and drawings, was used in order to reconstruct the ships from that time.

Introduction

Japan is an island country from where it is impossible to cross over to the continent without ships. This has been taken for granted and therefore, until the mid-twentieth century, little attention has been focused on ships and their history.

However, the concern with nautical history has been growing, and a considerable number of studies have been conducted on this subject, and have brought about substantial results.

Logboats have been broadly used since the prehistoric times and are generally the same from Europe to China. The earliest example of a logboat was found near Pesse in

the Netherlands, and dated to about 6300 B.C.E.

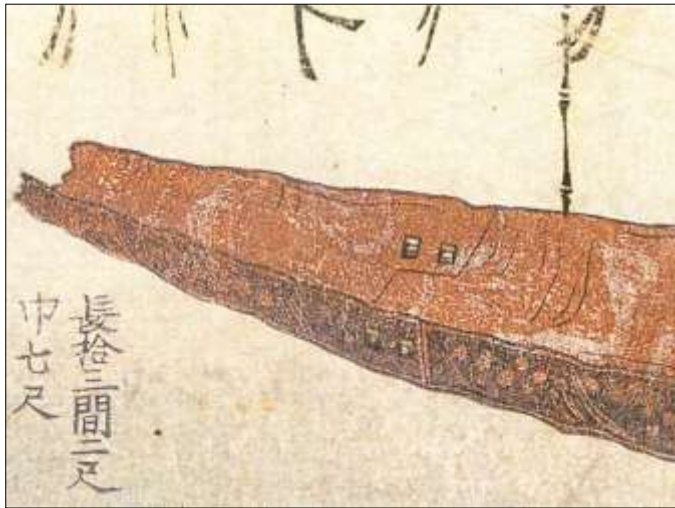
Although it seems that most complex ships developed from logboats, the process of development

from the primitive stage to a more sophisticated form is different in different areas. Ships in Northern Europe or in the Mediterranean developed first into shell-first or plank-built ships, then to skeleton-first or frame-first ships. Meanwhile, ships in China seem to have developed from logboats to extended log-

boats, and after that to junks, which were characterized by their structural bulkheads.



Ishii's development process of ships in the Seto Inland Sea



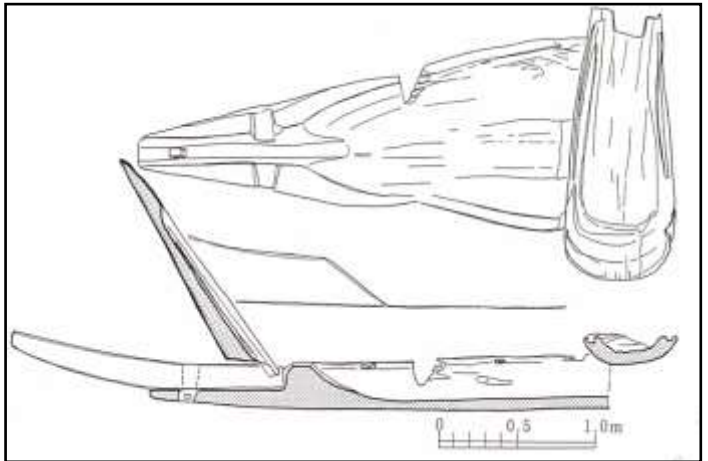
Morokuwa

Ships in Japan developed differently from those in other countries. Abundant archaeological evidence has been found from ancient times, unlike the medieval period (1167 – 1568 C.E.) and later, for which there is no evidence as yet.

Studies of ancient ships in Japan have been earnestly undertaken by Japanese archaeologists, historians, and folklorists since the second quarter of the twentieth century. The development process of

Japanese ships has been roughly explained.

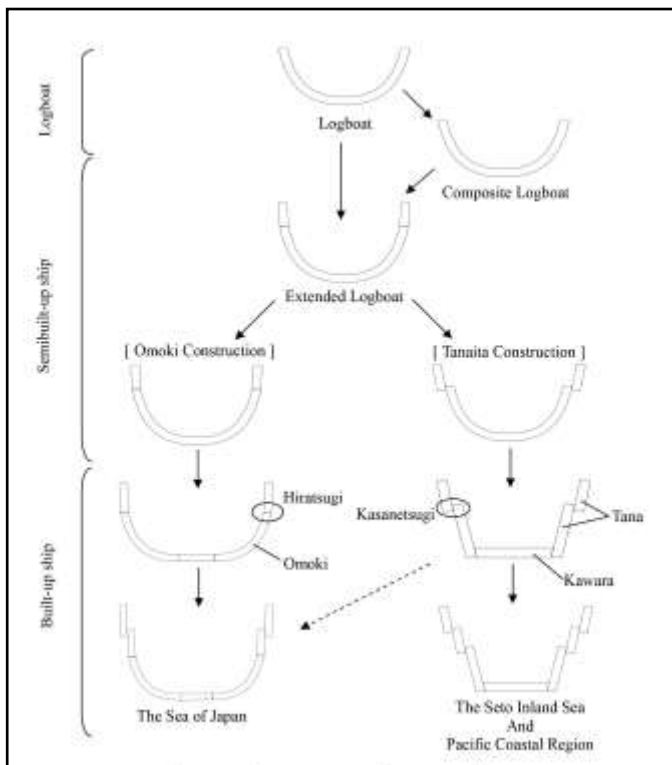
It is generally said that ships in Japan evolved in the following order: logboat, extended logboat and assembled craft. In this project a typology of the early Japanese watercraft was presented, based on both archaeological and ethnographic evidence.



Kyuhoji (after Okita 1995, 284.)

Citation

Myiashita, H., *Ancient Ships of Japan*. MA Thesis, Department of Anthropology, Texas A&M University.



Evolution of the Japanese boats, from logboats to extended logboats, to semi-built , and to built up ships

CONCLUDED GRADUATE WORK

George Schwarz

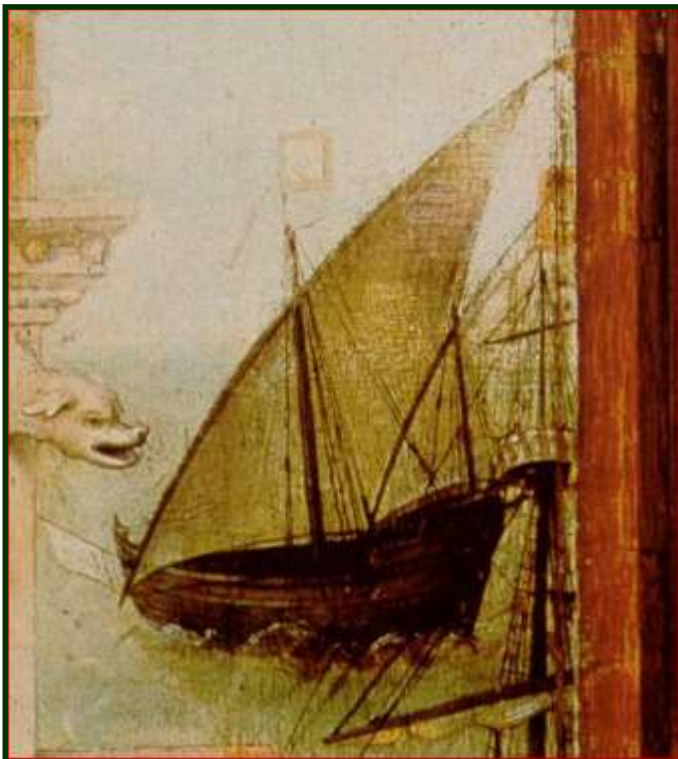
The History and Development of Caravels

MA, 2003-2008

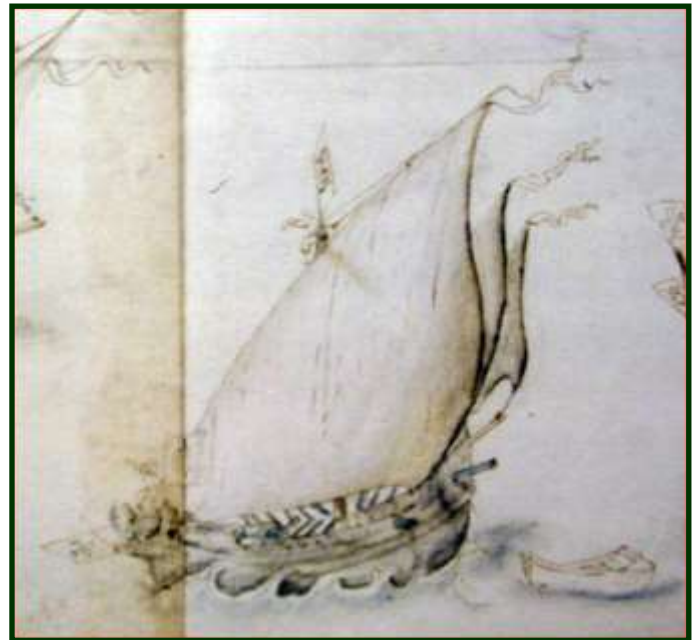
An array of ship types was used during the European Age of Expansion (early 15th to early 17th centuries), but one vessel in particular emerges from the historical records as a harbinger of discovery: the caravel.

Introduction

The problem is that little is known about these popular ships of discovery, despite the fair amount of historical evidence that has been uncovered. How big were they? How many men did it take to operate such a vessel? What kind of sailing characteristics did they have? How and by whom were they designed? Where did they originate and how did they develop? These questions cannot be answered by looking at the historical accounts alone. For this

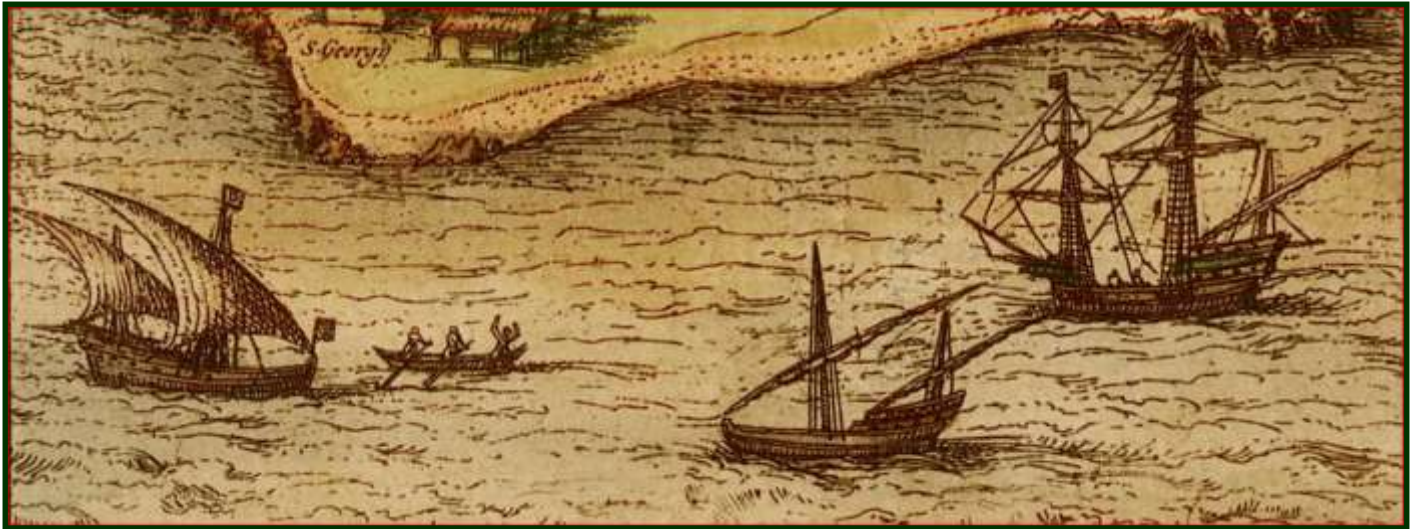


Early 16th century depiction of a caravel. Retábulo de Sta. Auta.



Caravel in the Leiden View of Lisbon, c. 1535.

reason, scholars must take another approach for learning about caravels by examining additional sources, namely ancient shipbuilding treatises, archaeological evidence, surviving archaic shipbuilding techniques, and iconographic representations from the past. Information gained from the available sources reveals many of the caravel's characteristics through time. This ship type outclassed its contemporaries during the age of exploration because of its highly adaptive characteristics. These traits were, principally, its shallow draught, speed, maneuverability, and ability to sail close to the wind. This combination of attributes made the caravel the ideal ship for reconnaissance along the



Braun and Hogenberg Atlas, 1572. S. Jorge da Mina.

rocky African coastline, as well as for making the transatlantic voyages to the New World. It was built in a Mediterranean way during its post-medieval phases, a method that still survives in some parts of the world today. During the Age of

is a body of information that can be applied to other studies about ancient seafaring, and can serve as a starting point for further research.

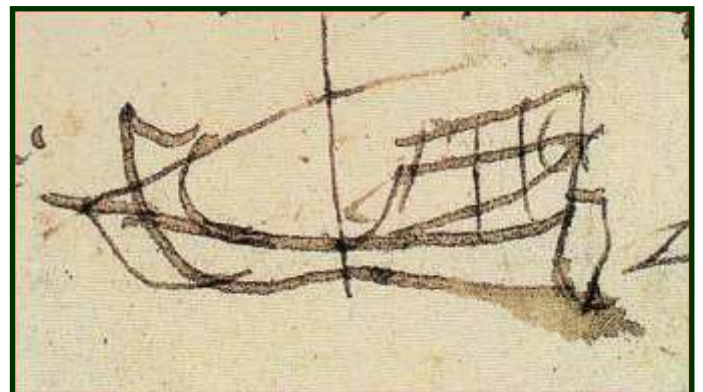
Citation

Schwarz, G., 2008. *The History and Development of caravels*. MA Thesis, Department of Anthropology, Texas A&M University.



Livro das Fortalezas. Duarte d'Armas, 1509. Valença do Minho.

Discovery (ca. 1430 to 1530), the caravel sat low in the water, had one sterncastle, and was either lateen-rigged or had a combination of square and lateen sails. This vessel reflects the advanced ship-building technology that existed in Europe at this time, and played an important role in the voyages which allowed the Europeans to expand their territories around the world. The results of the studies presented in this thesis provide a history and development of the caravel, which was gradual and often obscure. What has been gained from this work



Signature of João de Leão, late 15th century.

CONCLUDED GRADUATE WORK

Blanca Rodriguez Mendoza

Ordenanzas para la Fabrica de Navios de Guerra y Mercante - 1607, 1613, 1618

During the first two decades of the 17th century King Philip III (1598-1621) of Spain and Portugal launched an effort to standardize all shipbuilding in the Iberian Peninsula. These efforts of standardization constitute an important collection of information about Iberian shipbuilding practices of that period. This thesis will analyze the content of the three sets of ordinances, issued in 1607, 1613 and 1618, in the context of the history of the Iberian Peninsula, the regulation of the Carrera de Indias (Indies Trade), and Spanish shipbuilding practices based on written sources of that period.

(from Thesis) From its beginning and throughout the 16th century, the Carrera de Indias or Indies Trade was carefully regulated as part of the Spanish crown's strategy to create perhaps one of the first true world empires. By regulating the most important aspects of the seafaring that connected the empire (i.e. the formation of a fleet system, the routes and their timing, as well as the establishment of armadas for the protection of the fleets), Spain became the most important European naval power during this period.

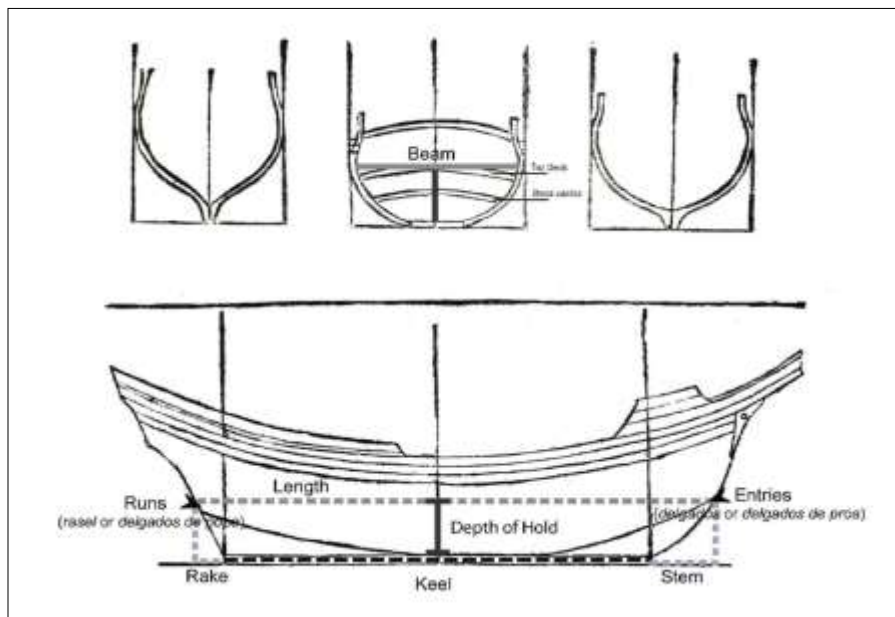
By the end of the 16th century, Spain's naval power

was increasingly threatened by the rising importance on the naval field of a number of Protestant nations, mainly England and the Northern Netherlands. Assuming the role of Catholic defender, Spain

invested a large portion of the monetary resources obtained from its colonies into a number of holy wars with these nations, causing a constant strain on the crown's finances, and thus putting its naval power at risk.

Following the 1588 Spanish Armada episode (in which King Philip II of Spain [1556-1598] failed an attempt to invade

England) and the disastrous 1601 Ireland campaign of King Philip III of Spain (1598-1621), the latter monarch realized the necessity of maintaining Spanish hegemony at sea. After arranging peace



Definition of the five main elements provided by Escalante de Mendoza illustrated



Replica of a model from the mid-16th century in the Museo Naval of Madrid.

treaties with his main enemies (France in 1598, England in 1604, and the Northern Netherlands in 1609), Philip III and his Consejo de Guerra focused their attention on a previously overlooked aspect of the Carrera de Indias: the regulation of Spanish shipbuilding as a means to regain Spanish supremacy at sea.

The result was a series of three royal decrees known as the *ordenanzas para la fábrica de navíos de guerra y mercantes* (ordinances for the construction of war and merchant ships). These ordinances encompassed an effort to standardize all shipbuilding in the Iberian Peninsula. Triggered by the necessities of operating a modern state, and mandated by the demands of the crown's extensive empire, these efforts of standardization constitute an important collection of information about shipbuilding practices of that period. This thesis will analyze the content of the ordinances issued in 1607, 1613, and 1618, in the context of the history of the Iberian Peninsula during this period.

Because of the lack of archaeological material regarding the manner in which Spanish vessels for the trans-Atlantic trade and its protection were built during the late 16th and early 17th centuries, the study of the historical record of this period is particularly important. Luckily, in addition to the

ordinances, a number of documents regarding the shipbuilding process of that period have survived. Included in these are four Spanish navigation and shipbuilding treatises and a handful of contracts and correspondence detailing the measurements of vessels' capacity.

Furthermore, there has not been a great deal written on the topic in secondary sources, since the study of the primary sources has been deemed more important. The texts that include information about the ordinances are mostly focused on the historical impact of the regulations in the larger concept of shipbuilding during the early 17th century.

Of these, only one study of the contents of the 1613 and 1618 ordinances has been published by José Luis Rubio Serrano, although it is not complete. To my knowledge, no in-depth study has been done regarding the contents of the 1607 ordinances.



View of Sevilla around 1600.

This study of the ordinances will be conducted by analyzing the primary sources available. The system of measurements used in ship design, as provided by the four Spanish treatises previously mentioned, will be reviewed in order to provide the context of the system of measurements used in Spain before the publication of the ordinances, during the transitional period of the publication of the ordinances, and after that period.

The study of the trends of the particular measurements considered in the hull design and in the calculation of ship's tonnage will also include relevant information contained in correspondence and contracts.

Citation

Mendoza, B. Rodriguez, 2005. *Standardization of Spanish Shipbuilding: Ordenanzas para la Fábrica de Navíos de Guerra y Mercante – 1607, 1613, 1618*. MA Thesis, Department of Anthropology, Texas A&M University.

CONCLUDED GRADUATE WORK

Randall Sasaki

Kublai Kahn Lost Fleet

MA, 2002-2008

In 1279 C.E., under the rule of Kublai Khan, the Mongols sent a fleet of more than 4000 vessels to subjugate the island nation of Japan, when a powerful typhoon crushed the invading fleet into pieces. The great wind, called kamikaze, or divine wind, thus saved the nation from foreign rule.

In the twelfth and thirteenth centuries C.E. East Asia was experiencing a great expansion in maritime commerce led by the powerful Chinese state of the Southern Song dynasty (960-1279 C.E.).

At the same time, the nomadic tribe known as the Mongols became a powerful empire and began to threaten the civilizations of East Asia. In 1274 C.E., Kublai Khan, the emperor of the Mongols, sent 900 Korean-made vessels to attack Japan, but was only successful in burning the international city of Hakata. After this invasion, Kublai set his eyes on conquering the maritime nation of Southern Song; he was successful in defeating the state and established the Yuan dynasty (1279-1368 C.E.).

Again in 1281 C.E., Kublai sent a massive fleet, this time consisting of more than 4000 vessels from



An illustration of a vessel in *Mōko Shūrai Ekotoba* Scroll.

southern China and Korea. When they approached the island of Takashima in western Japan, a great typhoon known as a Kamikaze, or divine wind, destroyed the vessels.

Historical sources suggest there were three main types of vessels involved in this event: V-shaped cargo ships for transporting provisions to the front, constructed in the Fukien province in China; miscellaneous flat and rounded bottom vessels made in various areas along the Yangtze River; and flat bottomed landing crafts from Korea.

In the recent past the remains of the fleet were discovered at the Takashima underwater site in western Japan, unveiling numerous artifacts including weaponries, ship board items, and hull sections. The site consists of remains of ships built in China and Korea.

The interpretation of the artifacts is thus extremely complex. In order to determine the origin of the



Excavated Timbers kept at Takashima Board of Education.

vessels, a logical framework was necessary.

The author created a timber category database, analyzed joineries, and studied the philosophy of shipbuilding to ascertain the origin and types of vessels.

Although no conclusive statements can be made regarding the origins of the vessels, it appears that historical documents and archaeological evidence correspond well to each other, and that many of the remains analyzed were from smaller vessels, built along the Yangtze River Valley.



3D model of the artifact dispersion (Randall Sasaki).

A large V-shaped cargo ship and the Korean vessels probably represent a small portion of the timbers raised at the Takashima site. As the first research project of its kind in the region, this study is a starting point for understanding the real story of the Mongol invasion of Japan, as well as the history of shipbuilding in East Asia.

In order to study the origin and types of the vessels involved in the invasion, it is important to know how the invasion was organized. It is apparent that from careful readings of historical materials regarding Kublai Khan's campaigns that he was a master in organizing the resources and people needed to efficiently execute his missions. Kublai probably knew that taking over the island nation was not going to be easy. The most logical approach in conquering Japan was therefore to establish a strong base in Japan in order to slowly advance inland while minimizing the loss of troops.

Publications

Sasaki, R., "Preliminary Report of the Archaeological Investigation of the Mongol Invasion of Vietnam" in *Museum Catalogue Booklet for the Kyusyu National Museum Exhibit on Great Viet-*

namese Archaeology. 2013...

Kimura, J., R. Sasaki, and V.T. Long. "Historical development of Asian anchors, evidenced by two wooden anchors found in northern Vietnam." *The International Journal of Nautical Archaeology* (2011) 40: .

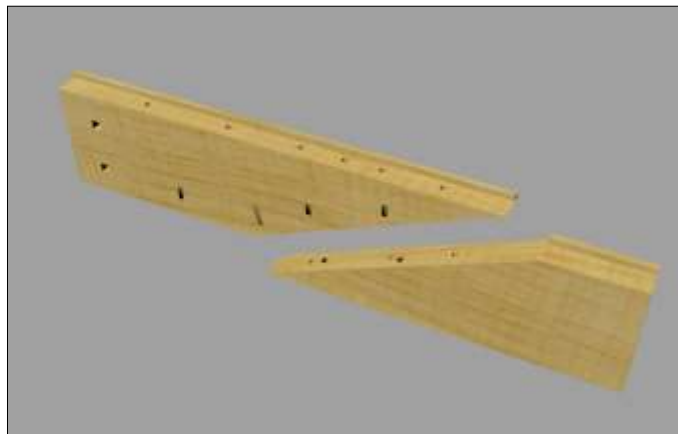
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Sasaki, R., *The Archaeology of Kamikaze: Revealing the Secret of Mongolian Navy* (Texas A&M Press, in final review).

Citation

Sasaki, R., 2008. *The Origin of the Lost Fleet of the Mongol Empire*. MA Thesis, Department of Anthropology, Texas A&M University.

Sasaki, R., 2015. *The Origins of the Lost Fleet of the Mongol Empire*. College Station: Texas A&M University Press.



Model of a scarf in one of the ship remains recovered from this site (Randall Sasaki).

CONCLUDED GRADUATE WORK

Tiago Fraga

Santo António de Tanna: Story and Reconstruction

Buy a puzzle, assemble it, and destroy its original box. Take the puzzle, go to a lake, throw the puzzle in the lake, and leave it for a few weeks. Return to the lake and try to rebuild the puzzle from the remaining pieces.

From the thesis:

Such is the challenge of the research goals presented on this abstract – the reconstruction of a Portuguese frigate, Santo Antonio de Tanná, from its submerged remains.

This thesis focuses on the mechanisms of reconstructing the ship, including the thought process, new computer tools, and imagination required for an archaeologist to be a detective of lost eras.

The main objective was to understand the construction of a late Seventeenth-century Portuguese frigate. Frigates were responsible for patrolling the seas, intercepting fast moving vessels, resupplying military trading stations, and protecting trade routes.

The existence of Portuguese frigates was known

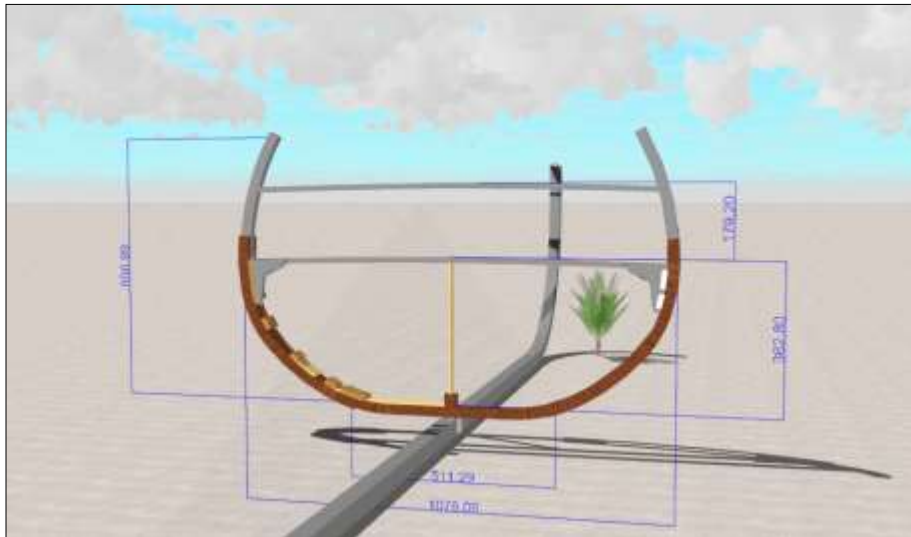
from historical records, but Santo Antonio de Tanná is the only frigate identified in the archaeological record. As such, its reconstruction should enable scholars to better understand the actual capabilities of seventeenth century frigates.

A particular challenge in this study was ascertaining the manner in which Santo Antonio de Tanná's construction reflected the state of affairs of the Portuguese trade network.

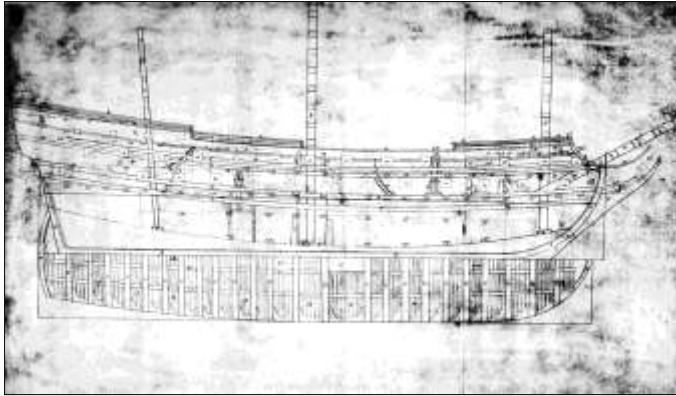
Although their construction methods were advanced, the Portuguese adopted a shipbuilding design that was not able to compete as well in the new conditions of a

changing global context.

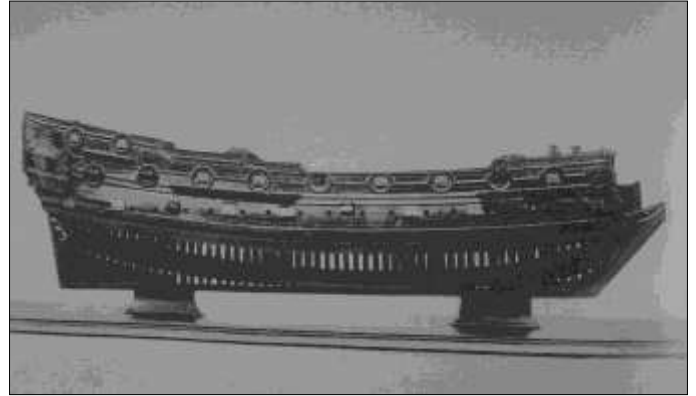
This study clearly demonstrate that cargo capacity was given greater emphasis than either speed or maneuverability, illustrating the on-going necessity of the Portuguese to build military ships with cargo capacity sufficient for minimal trade, even at the



The author's reconstruction of the ship's midship frame.



Deane's frigate drawing. (After Lavery 1981, 75)



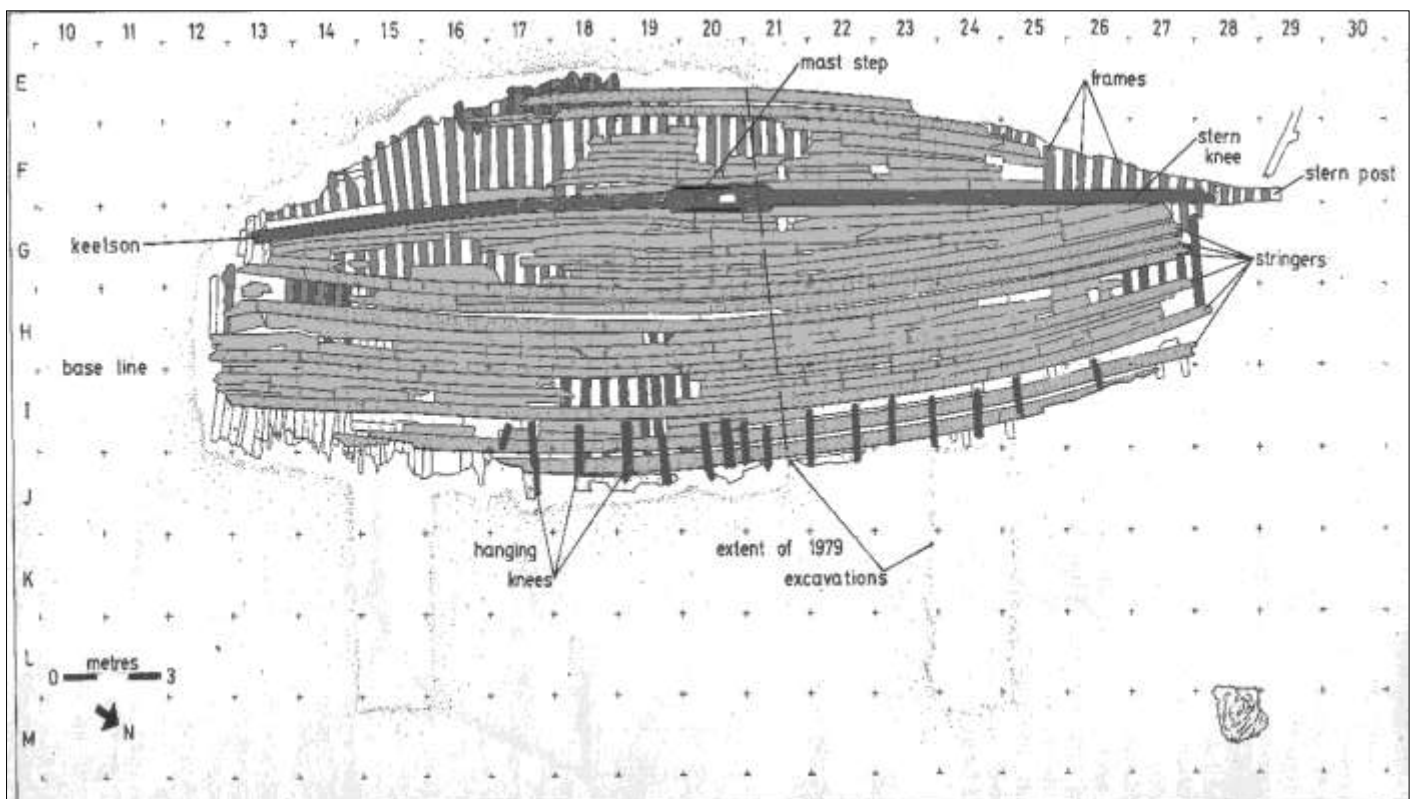
Model of a 44-gun fourth rate. Its name is unknown but it bears the inscription "Bristol 1666". (Culver 1954, 9)

expense of speed. These were just the first steps in terms of what could be learned from the reconstruction.

The best method to understand the ship, a three-dimensional object, was to recreate it into a three-dimensional environment in order to create a more accurate model. The resulting model permitted research to extend beyond the limits of the individual line drawings through the added benefit of being able to calculate hydrodynamics, sailing characteristics, and other data based on the ship's morphology.

Citation

Fraga, T., 2007. *Santo António de Tanna: Story and Reconstruction*. MA Thesis, Department of Anthropology, Texas A&M University.



Plan of the 1979 excavation. (After Piercy 1979, 306)

CONCLUDED GRADUATE WORK

Timothy Kane

Influence and Evolution: The Development of the Batten Lug Sail

MA, 2002-2006

Since the forefathers of the ancient Chinese populated the highlands of central Asia some 700,000 years ago, this eastern culture has often eclipsed the western world with its technological advances. Perhaps the single most poignant example of China's historical primacy is its long history of naval innovation.

From the thesis Abstract:

With its ease of reefing, subtle control, and unmatched ability to generate thrust effectively in both severe and minimal weather, the Chinese batten lug is perhaps one of the most sophisticated sails in history. However, its development remains unclear, as its relatively sudden appearance in the iconographic record as a mature technology, and its seeming lack of affinity to other Chinese sails, gives no indication of a regional evolution.

An analysis of the batten lug suggests that it likely descended from some simpler sail. As it is separated from the most rudimentary square rig by several key features, the batten lug's development probably occurred in an incremental, or stepwise, fashion. But, no intermediate form representing such progression of the batten lug has yet been discovered in China, or even in the greater Pacific basin. An examination of iconographic evidence from India and the western reaches of the Roman Empire, however, suggests that sails bearing battens or

possessing lug morphology existed in these regions prior to the emergence of the batten lug in China. The question therefore arises whether it is possible that these sails were ancestral to, or in some way influenced the development of, the more sophisticated Chinese sail.



Roman river craft of the Sarre/Moselle River region

In an attempt to answer this question, this thesis considers the significance of diffusion as a mechanism for the dispersal of ideas, both today and in antiquity. It also presents a review of the numerous artifacts and textual accounts that suggest commercial and cultural exchange occurred between the Roman Empire, India and China during the Imperial and early Medieval periods. As a result of these evaluations, it

seems possible, and even probable, that the technologies of these regions influenced each other. Considering this possibility, the likely evolution of the batten lug, and the distribution of potentially ancestral forms, this thesis concludes that the development of the batten lug in China may indeed have been influenced or inspired by the sails of In-



Single-element construction of battens (from Needham 1971, plate CDXXII).

dia and the western Roman Empire.



The Chinese batten lug sail, from modern Fuchow (from Needham 1971, plate CCCXCII).

From the Conclusions:

There is no evidence for the regional existence of such ancestral forms in either China or indeed the greater Pacific. Thus it would seem that some portion of the batten lug's development occurred elsewhere.

he discovery of two unique sails in the iconography of India and the Roman Empire seem to substantiate this notion.

A ship portrayed in a fresco from the Ajanta temple complex of northwestern India carries a sail that is more similar to the batten lug than any sail found in the Pacific. Tall and somewhat narrow, the sail is also clearly of lug design.

Another sail, depicted in a carving and a mosaic from Gaul in the western reaches of the Roman Empire, also seems to be quite similar to the Chinese rig of later periods.

Carried by a vessel quite distinct from Roman watercraft, and likely constructed of leather, this sail not only has a relatively tall aspect ratio but also bears battens. Consequently, both of these sails possess two of the three essential features characteristic of the batten lug, and therefore potentially represent proximal stages of its evolution.

Citation

Kane, G., 2006. *Influence and Evolution: The Development of the Batten Lug Sail*. MA Thesis, Department of Anthropology, Texas A&M University.

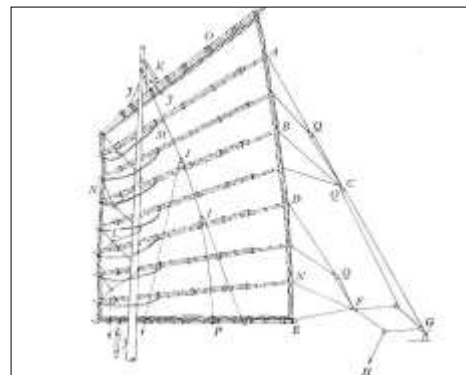


Diagram of the batten lug (from Needham 1971, 595.)

CONCLUDED GRADUATE WORK

Alexander Hazlett

The Textual Excavation of an India Nau

PhD, 2001-2007

Alexander's work is focused mainly upon the "textual excavation" of a nau of the Carreira da India (the "India Route"), describing the construction of the vessel timber by timber, following the methods of 16th-century shipbuilders and the dimensions and measurements specified in contracts and treatises. Using Rhinoceros 3 software to model the ship, he built the model directly from a list of timbers described in the anonymous manuscript Livro náutico ou meio pratico de construção de navios e galés antigas - Ms. F464 from the National Library, Lisbon, dated to 1580-1590 - which he translated and interpreted.

Although the primary source for this reconstruction was the regimento "Medidas pera fazer huma Nao di Seiscentas Tonilladas, e os paos que hà de levar de Sovoro e Pinho" from the *Livro Nautico*, Alexander used Fernando Oliveira's treatise *Livro da Fabrica das Naus* (c. 1580) extensively, and looked at numerous other original texts when it was necessary to understand a cryptic passage or term in the *Livro Nautico*. Another text used was written around a decade later, was João Baptista Lavanha's treatise *Livro Primeiro de Architectura Naval*.

Data derived from these sources was compared to those found in other treatises, iconography, and the archaeological record. The reconstruction was based on a hypothesized construction sequence, mainly based on the order in which the timbers are presented in the *Livro Nautico* document. Neither the treatise of Oliveira nor that of Lavanha contradict this sequence of building operations.

Shapes were defined using the geometrical formulas and other data contained in the ship treatises of the period, or found in the archaeological record.

The model was defined using *Rhinoceros 3* three-dimensional modeling software. The end result of this project is an annotated model, illustrated by a 3-D model, presented on the next page.



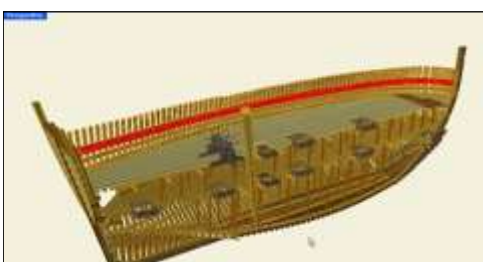
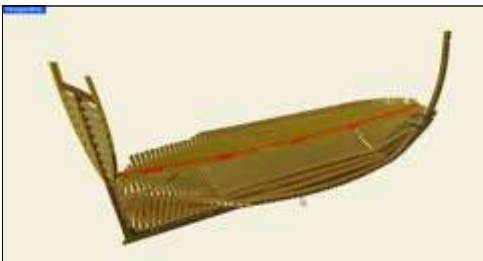
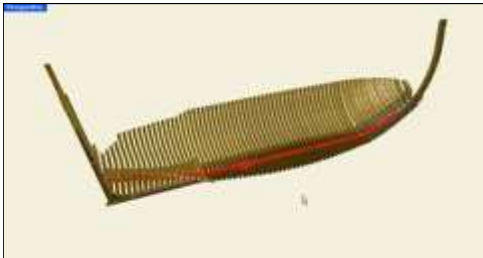
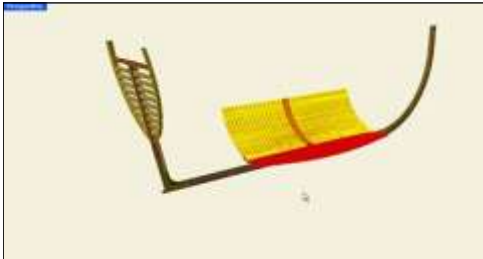
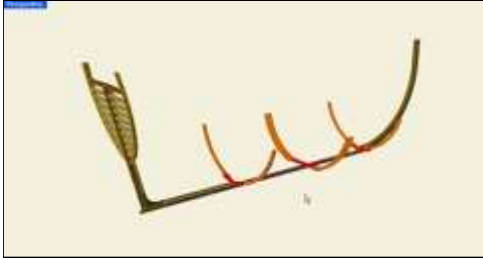
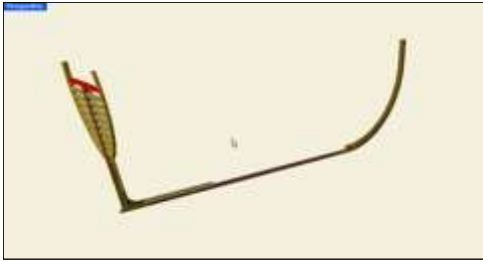
A folio of the *Livro náutico* manuscript.

Written around 25 years later than the vessel described in the *Livro Nautico*, and showing a larger vessel, the treatise of Manoel Fernandez - *Livro de Traças de Carpintaria*, 1616 - was very important to help decoding the meaning of certain timber names. Fernandez' drawings and scantling gages are a tremendous primary source for the understanding of Portuguese shipbuilding in the period.

One last source utilized was the Spanish treatise by Diego Garcia de Palacio, *Instrucion Nautica Intrvcion navthica para el bven vso, y regimiento de las Naos, su traça, y gouierno conforme à la altura de Mexico*, dated to 1587.

Citation

Hazlett, A., 2007. *The Nau of the Livro Nautico: Reconstructing a Sixteenth-Century Indiaman from Texts*. PhD Dissertation, Department of Anthropology, Texas A&M University.

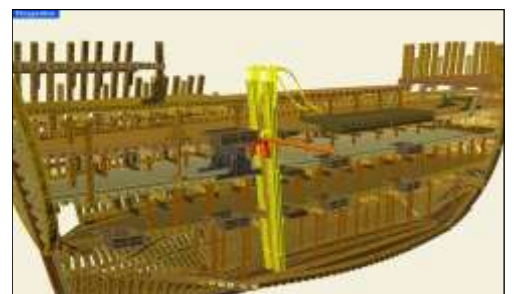
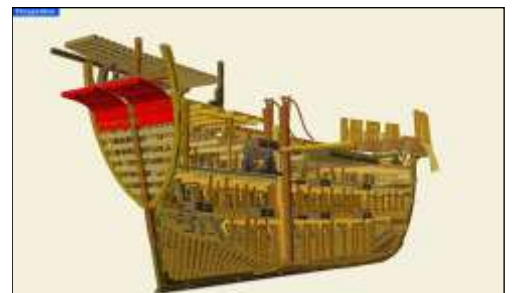
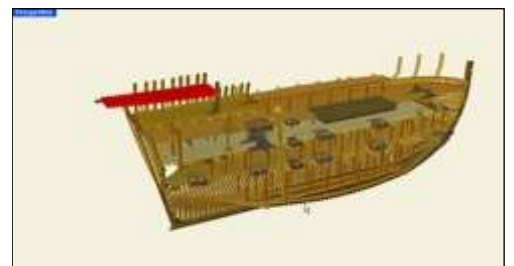
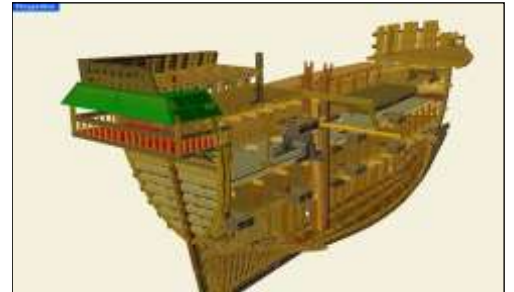
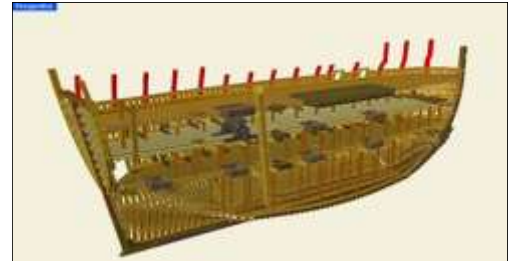


Each timber of the *Livro náutico ou meio pratico de construção de navios e galés antigas* regimento “Medidas pera fazer huma Nao di Seiscentas Tonilladas, e os paos que hà de levar de Sovoro e Pinho” was detailed, designed in 3D and assembled following the traditional methods, as prescribed in the coeval shipbuilding treatises.

Because this text contains the number of timbers of each kind that are necessary to build a 600-ton *nau*, Alexander was capable of achieving an impressive level of detail, for instance in what pertains to the spaces between frames or deck beams.

These values were then compared to the available data from shipwrecks and other texts which greatly improved the plausibility of his reconstruction.

Alexander’s model was later expanded and fine-tuned by Nuno Fonseca, Tomás Vacas, and Tiago Santos, the team from the *Centre for Marine Technology and Engineering*, *Instituto Superior Técnico* that tested the Pepper Wreck reconstruction with numerical and physical models, in order to evaluate its intact stability and its performance under sail.



Some of the many construction phases detailed by Alexander Hazlett in his seminal study of this type of construction.

CONCLUDED GRADUATE WORK

Gustavo García

The Rincón Astrolabe Shipwreck

On 30 December 1986, a local fisherman incidentally discovered the remains of a seventeenth-century merchantman off the coast of Rincon, a small municipality on Puerto Rico's west coast. Some days later, he and some acquaintances extracted objects from the site and stored them in a nearby restaurant. The assemblage of artifacts recovered included, among other items, pins, scissors, ordnance, pewter ware, woodworking tools, a myriad of concretions and a nautical astrolabe.

From the thesis Abstract:

It is from the last that the wreck site took its name. The operation continued for months until local authorities, alerted by a member of the salvage group, issued a cease and desist order. At that point, the whole affair entered a legal process that on the summer of 2005 had not reached its conclusion. The purpose of this thesis is twofold. First, the author presents the story of the shipwreck from the moment it was found until the court ruled regarding ownership of the artifacts. Since this was the first time ownership of a shipwreck was debated in Puerto Rican courts in recent history, this gives the reader an idea of how legal precedence

was established concerning the island's submerged cultural resources. Second, based on what was popularly perceived to be the site's most remarkable find, a study was developed on the sea or mariner's astrolabe, a navigation instrument that played a fundamental role in the process of European maritime expansion during the late fifteenth, sixteenth and seventeenth centuries.

The reader of this text will learn that, during the fifteenth century, Portuguese navigators saw the need to gradually depart from the traditional Mediterranean navigation technique known as "dead reckoning." As their explorations along the West African coast forced them to sail far into the Atlantic Ocean for



Rincón astrolabe.



Iron gun salvaged from the site in the 1980s. (Photo: Juan Vera)

prolonged periods, a new method was developed that consisted of measuring the angle of certain heavenly bodies above the horizon in order to determine the latitude of the observer with reasonable precision.

For this purpose, instruments that traditionally belonged to the field of astronomy were adapted to be used by seamen. Among them was the astrolabe, which became the most popular by the turn of the sixteenth century.

After discussing the instrument's origin and development, the author analyzes how a renewed interest on the nautical astrolabe, which emerged in Portugal in the early twentieth century, introduced the instrument to the field of modern scholarly research.



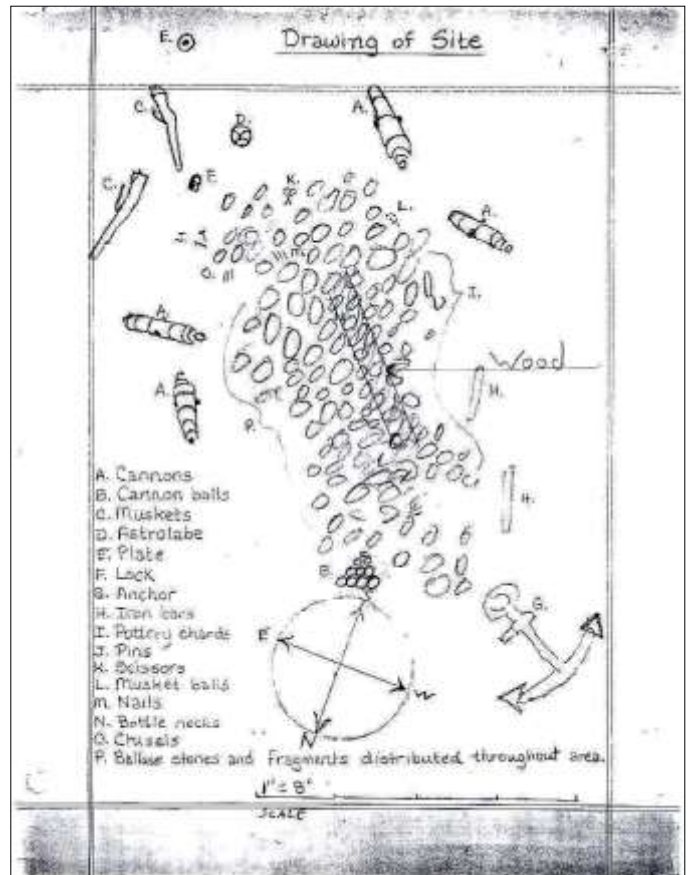
Section of a gun barrel salvaged from the shipwreck site.

This work also presents a catalogue of sixteen sea astrolabes, some of which have never been published. The catalogue shows statistics and other relevant information, while placing the artifacts in the context of the previously existing data.

These sixteen new mariner's astrolabes are an addition to Alan Stimson's astrolabe catalogue from 1988, and bring the number of known astrolabes to 81.

Citation

Garcia, G., 2005. *The Rincón Astrolabe Shipwreck*. MA Thesis, Department of Anthropology, Texas A&M University.



Early sketch of the site. See the final site plan on page 51.



Nicholas Kelk maker's mark, found on one of the pewter plates retrieved from this shipwreck. From the touch-plate of the Worshipful Company of Pewterers, with marks dated c. 1680 (after Howard Cotterell's *Old Pewter: Its Makers and Marks*).

CONCLUDED GRADUATE WORK

Katie Custer

Wrought Iron Hand Tools from Port Royal, Jamaica, C. 1692

MA, 2000-2004

This thesis is a continuation of the catalog of hand tools from the Port Royal excavations previously done by Ms. Marianne Franklin. It seeks to link the historical background of these artifacts to tool technology and the history of Port Royal and its tradesmen through the use of historical documents.

From the thesis:

The written history of Port Royal starts with the European discovery of Jamaica on Columbus' second voyage to the New World and has proven to be rich in shady characters and natural disasters. The English took possession of Jamaica from Spain in 1654 and the city of Port Royal was established soon after.

Port Royal, located at the end of the Palisadoes sand spit, a natural barrier roughly six miles long, separates Kingston harbor and the Caribbean Sea. Originally functioning as a protective fortification of the harbor, it became an active harbor and the most economically important English colony in the New World from 1655-1692. Port Royal quickly earned the title of "Wickedest City on Earth" because of its reputation of officially sanctioned privateering and piratical expeditions, and the abundant supply of establishments of ill repute. On

Wednesday June 7, 1692 a devastating earthquake struck Port Royal and destroyed a major portion of the city.

A total of 33 acres, or 66% of the city, including buildings and people, at the very end of the sand

spit, literally sank into the shallow harbor. It was not until the concentrated efforts of the Nautical Archaeology Program (under the direction of Dr. Donny L. Hamilton), the Institute of Nautical Archaeology, and the Jamaican government, started archaeological excavation from 1987-1993, that the



Port Royal and the 1692 earthquake.

real picture of this sunken city emerged. Through the excavation, mapping, collection, and conservation and analysis of artifacts a ghost image of this city was brought back to life and interpreted. A large collection of iron hand tools from this site was preserved. These conserved and replicated artifacts are now available for analysis. (...)



Port Royal shoreline through time.

in Port Royal, and the environment in which they worked. The relationship between the merchants and the townspeople, and the merchants and the tradesmen, was explored in order to discern if the tools were locally manufactured or imported, and from whom they were purchased. It was also necessary to find out what tools the tradesmen were using, and if they were trade-specific. These conditions were only partially explained through the other chapters, and it is on such conditions that the research questions previously posed are based.



Excavating Port Royal.

This thesis was intended as a continuation of the catalogue presented in the Franklin Thesis, set out to illustrate the artifacts by examining the people who would have used them.

The probate inventories provided details of trades and tradesmen, and in adding historical context a background was set to study the artifacts. It was important to find out what tradesmen were working

Citation

Custer, K., 2012. *Wrought Iron Hand Tools from Port Royal, Jamaica, C. 1692*. MA Thesis, Department of Anthropology, Texas A&M University.



CONCLUDED GRADUATE WORK

Erika Laanela

Diego García de Palacio's *Instrucción náutica*

MA, 1999-2008

In 1587, an ambitious colonial bureaucrat in Mexico City published a handbook titled Instrucción náutica para el buen uso y regimiento de las naos, su traça, y gobierno conforme à la altura de Mexico. Although navigational books were common throughout the 16th century, the Instrucción náutica was the first printed volume that included an extensive discussion of the ship construction and design. In order to understand the significance of the book, its context and content must be critically evaluated.

From the Thesis' Abstract

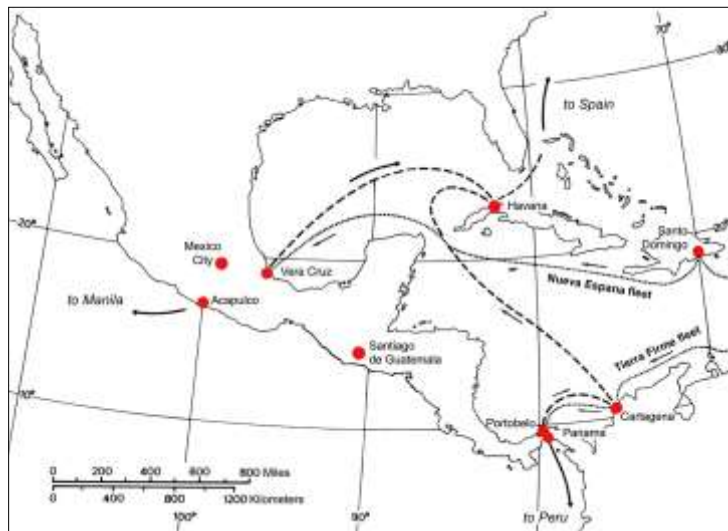
The book's author, Diego García de Palacio, held positions of academic, religious, and political power in New Spain. His motives for publishing the work were complex and he appears to have consulted a range of disparate sources of information. The navigational information included in the *Instrucción náutica* reflects information adapted from existing sources, providing a solid overview of the most common techniques of navigation in use at the time. Significant innovations made by include the calculation of dates using the Gregorian calendar introduced in 1582 and the computation of a lunar almanac for the meridian of Mexico City.

In terms of technical knowledge, the most original contributions of the *Instrucción náutica* are the descriptions of the design, construction, and rigging of Spanish ships in the late 16th century. The text

also includes a comprehensive enumeration of the officers, minor officials, and crew of a merchant ship. Although brief, the discussion of naval strategy is historically significant due to its juxtaposition between the last of the great naval battles fought primarily with boarding tactics, and the movement toward increasing reliance on the broadside.

The publication of the *Instrucción náutica* was a significant event in the history of early modern nautical technology, and García de Palacio has been called the "author of the first technoscientific work in the Americas." As with any historical document, it is crucial to consider the context

of the *Instrucción náutica* and the motivations and background of its author. Significantly, García de Palacio was an observer and administrator of navigation and ship construction, rather than an expert practitioner, and this should be remembered when evaluating his book. Nevertheless, the reputation of the *Instrucción náutica* as one of the



16th-century Spanish fleets in the New World. (After Wolf 1997)



Title page of the *Instrucción náutica* (After García de Palacio 1944)

most comprehensive sources of information on 16th-century Spanish seafaring practices is well justified.

From Chapter II - The life of Diego García de Palacio:

A wealth of archival documentation has survived to illuminate the life story of Diego García de Palacio. His biography, interwoven through a historical tapestry that encompasses many significant events in late 16th-century New Spain, reveals a complex personality combining ostensibly incongruous traits. The portrait that emerges is of an intelligent and inquisitive observer and a conscientious and competent bureaucrat, but also of an artful manipulator who was eventually ruined by the many op-

portunities for venality available to the colonial elite.

Much of what is known of García de Palacio's life is presented in a monograph first published by Othón Arróniz in 1980 and reprinted posthumously in 1994 by the University of Veracruz.

Arróniz's engaging study includes a perceptive biographical essay as well as transcriptions of 20 contemporary documents pertaining to García de Palacio discovered in Seville at the Archivo General de Indias (AGI) and in Mexico City at the Archivo General de la Nación (AGN) and other repositories. The esteemed Mexican historian Edmundo O'Gorman also published transcriptions of several important records concerning García de Palacio held in the AGN.

(...) In April 1572, García de Palacio was appointed to the post of fiscal (crown attorney) in the Audiencia de Guatemala.²⁶ An audiencia was the highest court of appeals in a colonial jurisdiction, hearing both civil and criminal cases, and its members also served as an advisory council to the viceroy. He was promoted to oidor (civil court judge) within a few months, despite the fact that he had not yet departed on his voyage to New Spain. The Crown provided him with 400 ducados to defray the cost of the trip, and gave him permission to transport weapons for personal protection and three enslaved Africans.

Citation

Laanela, E., 2008. *Instrucción náutica (1587) by Diego Garcia de Palacio: an Early Nautical Handbook from Mexico*. MA Thesis, Department of Anthropology, Texas A&M University.

J. Richard Steffy Ship Reconstruction Laboratory
105 Anthropology Building - 4352 TAMU - College Station, TX 77843, USA